Chemical Engineering

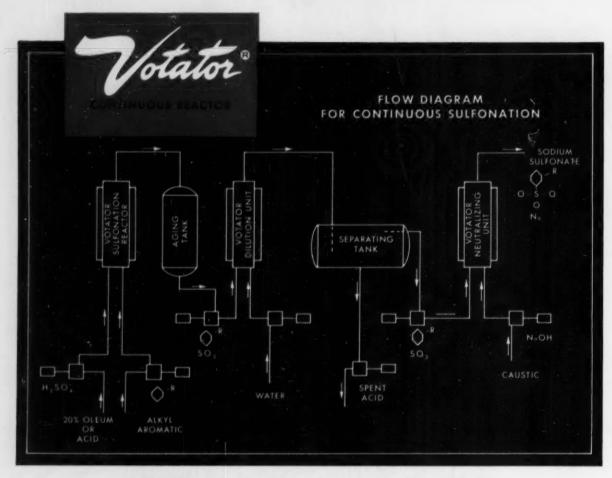
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MECHANICAL SEALS



Controls heat of reaction for processing viscous and heat sensitive materials

• If reaction temperature is your problem-you may profit from the experience of polymer manufacturers. They are now improving a wide range of products, stepping up reaction rates and increasing product uniformity with VOTATOR* Continuous Reactors.

Also, recent pilot plant studies in sulfonation indicate that VOTATOR Continuous Reactors simplify and improve this processing. A flow diagram of this Girdler pilot plant is shown above. Other suggested applications are sulfation, nitration and saponification.

Key to the efficient, low-cost operation of the VOTATOR Continuous Reactor is its rapid heat transfer rate. Over-all heat transfer coefficients of 200 to 500 BTU/(hr) (sq. ft.) (°F) are not uncommon. This high heat

speed transfer, coupled with simultaneous scraped-surface turbulent agitation gives precise control of reaction temperatures and permits you to heat or cool reactants in seconds . . . even those of high viscosity or heat sensitivity.

Find out how this compact, automatic equipment can improve your processing and cut your costs. Write today for further data. The Girdler Company, Votator Division, Louisville 1, Kentucky.

CHECK THESE ADVANTAGES:

- Highly efficient heat transfer and precise control of reaction temperatures.
- · Conducts reactions continuously without excessive pressure drops,
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- Immiscible reactants are maintained in finely dispersed state. Provides maximum contact between reactants.
- Reaction variables controlled automatically, uniformly. Safe, clean operation. Low operating costs. High daily output, Saves floor space.

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SEPTEMBER 1956

JOHN R. CALLAHAM, Editor

Your Third Inventory Issue

Within a month you'll get your own copy of our 3rd Annual Inventory issue. This is a special, 13th issue started by CE in 1954 as a new reference service for chemical engineers in all job functions.

In this year's Inventory issue we present our 7th annual directory of new plants and plant expansions in the chemical process industries. Taken as a whole, this seven-year series—covering almost 4,000 projects—is now the most complete tabulation of its kind available.

We're also presenting another annual checklist of major new processes and technology advances. This unique section will give pertinent facts on some 400 projects.

facts on some 400 projects.

Initiated by CE in 1951, this exclusive editorial feature has now listed close to 1,800 new technology advances. Naturally, it is one of the most popular sections of our Inventory issues.

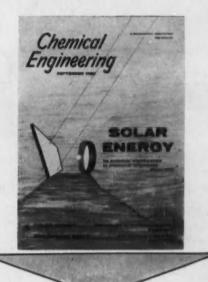
And, of course, we're continuing our inventory sections on new chemicals and raw materials, new equipment, and technical literature available from manufacturers.

This year's inventory of new chemicals includes 209 new or news-worthy items of interest to chemical engineers.

Our 3rd annual inventory of new equipment digests the significant facts on 410 of the most important developments during the past year.

You'll also see several improvements in this year's issue. For one thing, we now include appropriate literature items in each of the major sections. This makes all of them a more valuable reference.

Watch for your copy of CE's 3rd Annual Inventory issue. Use it now as a time-saving reference, save it as a permanent reference.



GUIDED TOUR



Solar energy: What its capture and use mean to today's chemical engineers

Solar energy has suddenly become a topic of high interest among process engineers. There's been real progress in that field! Our top-authority review of new advances emphasizes those that involve chemical engineering research, design, economics and operations. (p. 175)



More on handling compressible fluids

High-vacuum processing is now a largevolume operation. So now we're updating your know-how on pumps that produce such low-pressure conditions. It will supplement your June CE Report. (p. 181)



How many stages to extract a solid?

To answer this old question CE gives you a new graphical construction method that



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GUIDED TOUR

Chemical Engineering

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isn't based on simplifying assumptions. It's easy, can be applied more universally and with greater accuracy. (p. 185)



Spotlight on a low-finned newcomer

Until a few years ago there were only two main types of extended-surface heattransfer elements. Now a third one has proved its worth in the tough processing field. Why and how? (p. 189)



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Abrasive liquids: Handle with care!

How to install and use seals so that your centrifugal pumps can now handle abrasive liquids. A feature report that promises benefits for pump users throughout the process industries. (p. 199)



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Shifts in Soaps and Syndets Perk Profits Hugh T. Sharp	274	
Consumption Index	276	Chemical Engineering (with Chemical & Metallurgical Engineering) is published monthly with an additional issue in Mid-September by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office: 99-129 North Broadway, Albany 1, N. Y.
PICTURED FLOWSHEET		Executive, Editorial and Advertising: 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice President; Joseph A.
1121212	0.54	J. Kelly, Executive Vice President and Treasurer; Hugh J. Kelly, Executive Vice President; John J. Cooke, Secretary: Nelson Bond Executive Vice President
Upsurge in Tonnage O ₂ Units	354	Executive, Editorial and Advertising: 350 West 42nd St., New York 26, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice President; Joseph A. Gerardi, Executive Vice President and Treasurer; Hugh J. Kelly, Executive Vice President; John J. Cooke, Secretary; Nelson Bond, Executive Vice President Publications Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; J. E. Blackburn, Jr., Vice President and Circulation Director.
OTHER DEPARTMENTS		b Subscriptions: Write to Chemical Engineering—Subscription Service, 330 West 42nd St., New York 36, N. Y. Allow one month for change of address. Please show position and company connection on all orders. Single copies \$1 in U. S., Possessions and Canada; \$2 in all other countries. U. S. and possessions, \$3 per year, \$4 for two years, \$5 for three years; Canada, \$4 per year, \$6 for two years, \$8 for three years; canada, \$4 per year, \$6 for two years, \$8 for three years; canada, \$5 per year, \$6 for two years, \$50 for three years; all others: \$25 per year, \$40 for two years, \$50 for three years. Second class mall privileges authorized at Albany, N. Y. Printed in U.S.A. Copyright 1956 by McGraw-Hill Publishing Co., Inc. All Rights Reserved. Member A.B.C.
Advertisers	483	Single copies \$1 in U. S., Possessions and Canada;
Book Reviews	394	year, \$4 for two years, \$5 for three years; Canada, \$4 per year, \$6 for two years, \$8 for three years; other
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Technical Literature	454	40,869

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SEPTEMBER 1956

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PICTURED FLOWSHEET		Paul Montgomery, En Gerardi, Executive V
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OTHER DEPARTMENTS		Subscriptions: Wi Subscription Service, N. Y. Allow one mor show position and ce Single copies \$1 in \$2 in all other countryear, \$4 for two year per year, \$5 for two Westen Hemisphere: \$25 for two years \$25 for two
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Convention Calendar	132	Westen Hemisphere \$25 for two years, \$3
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CHEMICAL	ENGINEERING	

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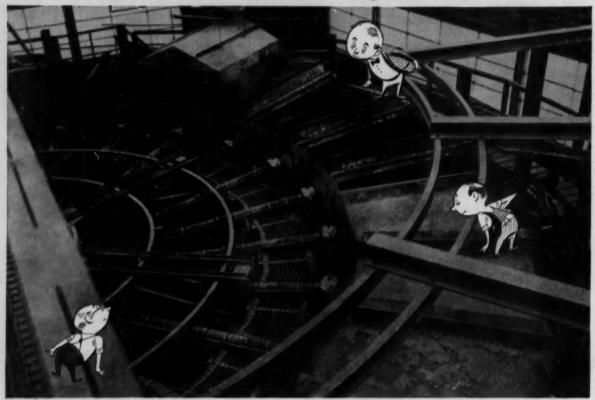
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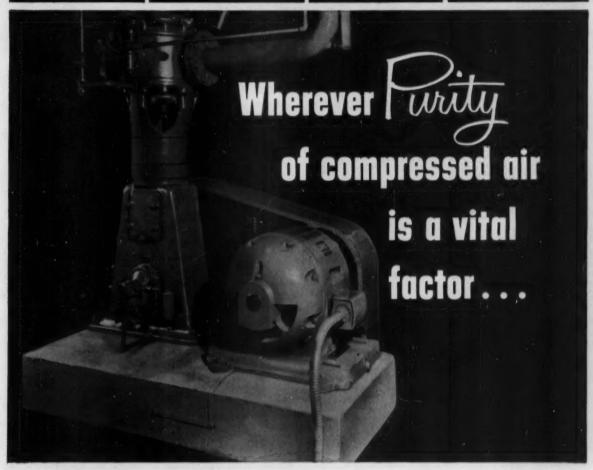
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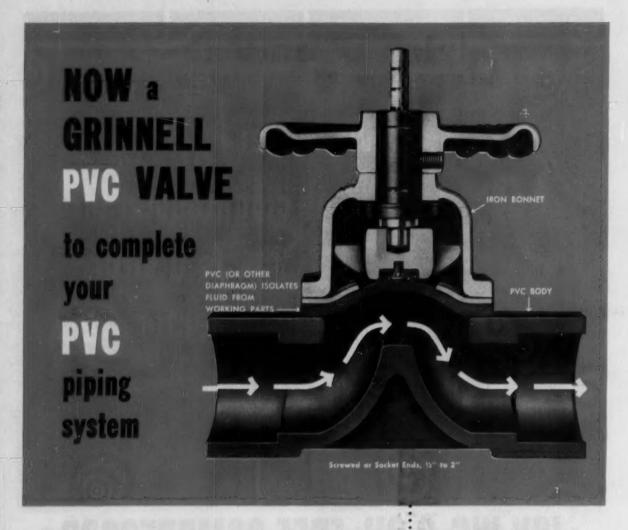








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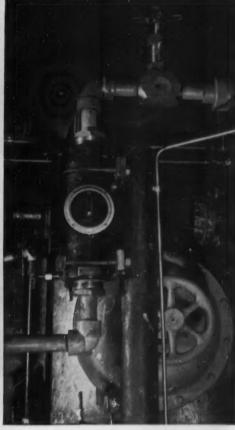


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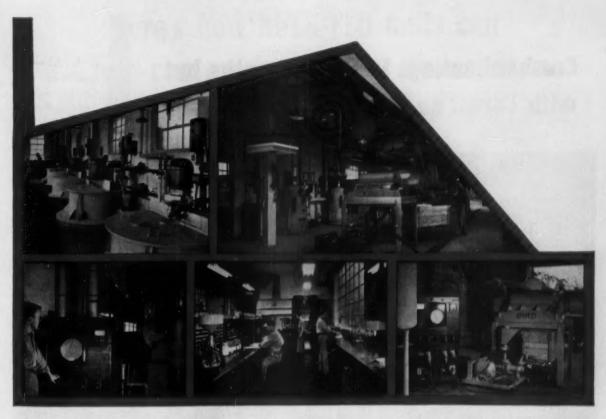
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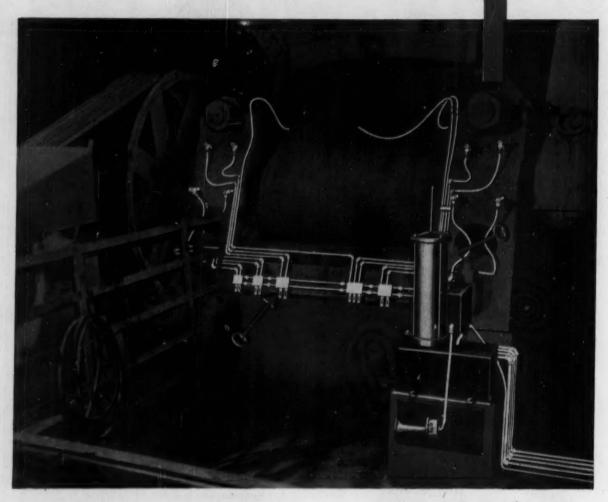
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Crusher bearings lasted 13 months, but with Farval no new ones in 6½ years

FARVAL— Studies in Centralized Lubrication No. 188



Back in 1949, an automatic system of Farval Centralized Lubrication was installed on this Fairmount Crusher. It paid for itself in 4 months by the savings in lubricant and labor that resulted.

In the nearly 7 years of its operation, Farval has returned rich dividends. Before the system was installed the life of a set of bearings was only 13 months. Today the identical bearings installed when the lubrication system was applied are still in service. Maintenance cost has been negligible. This success record led the cement company to specify Farval for a new mill crane and a power shovel.

Investigate Farval for your equipment. Write for Bulletin 26-R. The Farval Corporation, 3275 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacoch Brothers Limited.

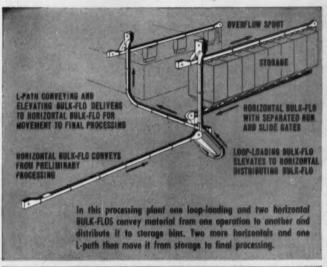
KEYS TO ADEQUATE LUBRICATION-

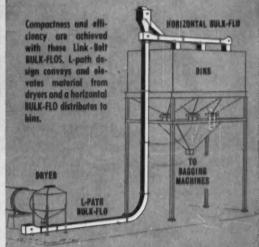
Wherever you see the sign of Farval—the familiar central pumping station, dual lubricant lines and valve manifolds—you know a machine is being properly lubricated. On this crusher in an eastern cement plant, savings in lubricant and labor, dua to Farval, run well over \$375 a month.

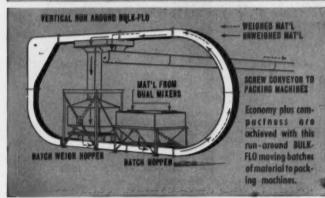


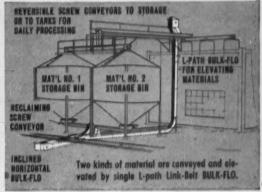
September 1956—CHEMICAL ENGINEERING

Here's how BULK-FLO units can feed-convey-elevate your materials









Single, compact, enclosed assembly . . . operates fully or partially loaded

S HOWN above are four of many handling variations possible with Link-Belt BULK-FLO. This single assembly moves materials along horizontal, vertical and inclined paths ... combines feeding, conveying, elevating. Flexible, compact and sanitary-BULK-FLO often replaces several handling units-in less space . . . at lower cost. Get complete information from your nearby Link-Belt office or send coupon for your copy of Book 2475 today.

SEE OUR EXHIBIT—NATIONAL CHEMICAL EXPOSITION— PHILADELPHIA-DECEMBER 5-9



BULK-FLO FEEDERS • CONVEYORS • ELEVATORS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



FULL OR PARTIALLY LOADED—Link-Belt BULK-FLO assures positive, gentle movement of material. Selfclearing through intermediate runs, it prevents contamination

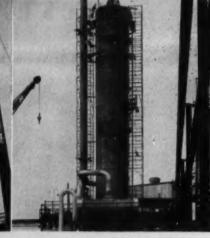
Bulk-Flo

LINK-BELT COMPANY
Prudential Plaza,
Chicago 1, Ill.
(Or your nearest Link-Belt office)

Please send me a copy of your 28-page BULK-FLO Book 2475.

Name City..... Zone... State.....





Stainless steel column was shipped to the site in two pieces. Carbon steel skirt and base also shipped in halves, field welded under Downingtown supervision.

Lining up for girth weld. Match marked sections welded in the field under supervision of Downingtown Iron Works personnel.

Completed column tested by Downingtown ...inspected by customer and by Hartford ...Code stamped on location. Ready for insulation when this shot was made.

More than 86,680 stainless steel welds in complex column by Downingtown

Diameter: 11' 11" I.D.

Total Height: 93' 11".

Material: Stainless steel, Type 304. Carbon steel skirt and base ring.

Shell Thickness: 1/2" and 1/4".

40 Trays and downcomers. 177 bubble caps and risers on each tray.

Code Stamping: National Board and ASME. Sandblasted and pickle washed.

Downingtown welders completed more than 86,680 separate stainless steel welds during fabrication of this stainless steel column. Tolerances of $\pm \frac{1}{16}$... $\pm \frac{1}{16}$... even $\pm \frac{1}{12}$... were maintained in the shaping, positioning and welding of thousands of stainless steel parts. Lapsed time from drawing board to final field testing: less than six months.

Send for Bulletin PF. It tells the story of Downingtown skill and experience that enable us to breeze through complex fabrication jobs like this one.



Column section showing bubble tray in place. Skillful welding was required to hold extreme tolerances on flatness of trays... level of weirs... placing of 7080 bubble caps.



Special jig for welding stainless steel risers to stainless steel tray. 177 risers and bubble caps per tray. 40 trays and downcomers. Note manhole in center.



Drilling riser holes in tray. The 40 trays, ½" thick, were solid stainless steel. Trays were positioned in column with leveling lugs and pins, then welded to shell and downcomer.

Downingtown Iron Works, Inc.

HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION 140 Wellings Ave., Downingtown, Ponnsylvania—Branch Offices



52 Vanderbilt Ave., Rm. 2025, New York 17 • 203 Hanns Bidg., Cleveland 15, Ohio • 936 W. Peachtree St., N.W., Rm. 113, Atlanta'3 • 208 S. LaSalle St., Rm. 792, Chicago 4
553 Reservait Bidg., Los Angeles 17 • 4550 Main St., Rm. 206, Kassas City 6, Ma. • Division of Pressed Steel Tank Company, 1447 S. 66th St., Milwaykee 14, Wis.

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS



Safest way to mix acid and water

It's 1949 and you're in a quandary.

You're a Purchasing Agent for a big chemical company. Your problem: To find a lining for chemical barges that can handle both muriatic acid and concentrated caustic soda.

This has never been done successfully before. However, you're off to a good start by calling in the G.T.M.—Goodyear Technical Man. He believes PLIOWELD—special corrosion- and abrasion-resistant rubber lining—can do the job, but suggests a thorough testing program to be sure.

One, two, three years roll by. PLIOWELD proves itself

first in the laboratory, then in the field. Result: Today, PLIOWELD protects six 40,000-gallon, bottle-shaped tanks aboard the world's largest seagoing chemical tanker against acid and, if ever necessary, alkali attack.

Another result: Whenever you have a problem on any type of industrial rubber, one of your first calls is for the G.T.M. His services are readily available through the Goodyear Distributor or Goodyear, Industrial Products Division, Akron 16, Ohio.

It's smart to do business with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and nonrubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."

PLIOWELD TANK LININGS by

GOODFYEAR

THE GREATEST NAME IN RUBBER

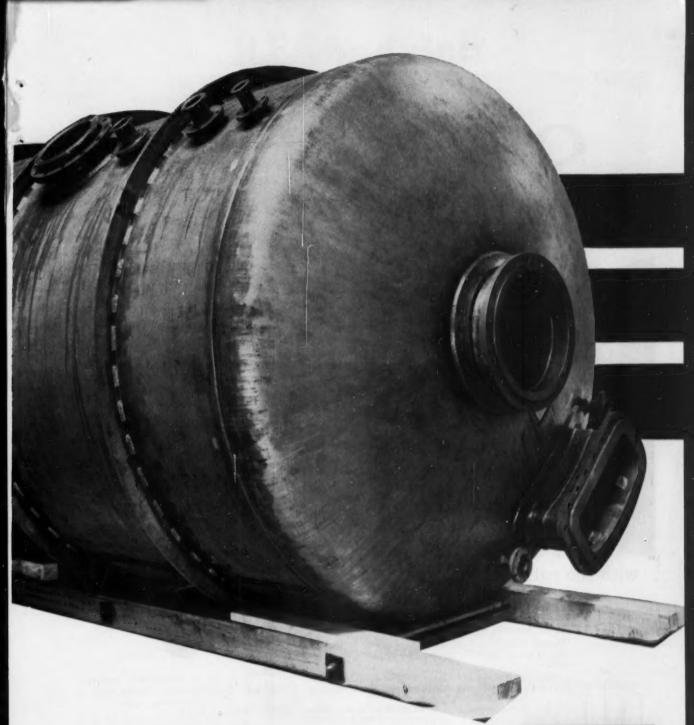
BRIGHTON BUILDS THE BIG ONES...

In unusual combinations of metals! This 5,000 gallon pressure vessel uses %-inch copper-silicon. The alloy was chosen for its increased resistance to corrosion, extra long wear. The vessel is 8 feet in diameter and 15 feet long. Maximum working pressure is twenty pounds or full vacuum. Welding by shielded arc process to reduce oxidation.

Besides unusual alloys like copper-silicon, Brighton metalsmiths are skilled in working all standard types of metals — stainless steel, copper, bronze, aluminum, nickel and monel metal.

We build with precision to your specifications, chemical process equipment of virtually any size — pilot models to full scale. Typical jobs include: reactors, fractionating columns, heat exchangers, pressure vessels, agitators, kettles, tanks, coils, evaporators. You can be sure of a prompt estimate on your fabrication work. Write today for complete information.

Have Brighton bid your big ones!



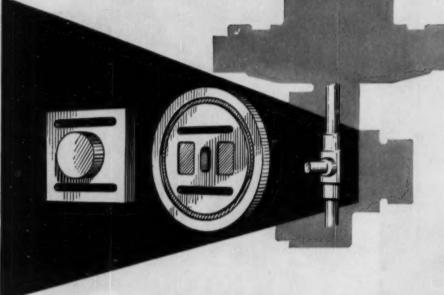
BRIGHTON CORPORATION

822 State Avenue, Cincinnati 4, Ohio Process Equipment for the Chemical Industries since 1914



OPW-JORDAN

temperature and pressure regulator valves



with the patented SLIDING GATE*

*the heart of the OPW-Jordan Valve specifically designed to overcome wire drawing, valve leakage, poor control, chatter, excessive maintenance.

Unusual sensitivity, dead end shut-off, close control, selflapping action. Metallic diaphragm—no lubrication neces-

Investigate all of the advantages of OPW-JORDAN SLID-ING GATE. Superior in design and performance!

*JORDAN's Trade Mark for its variable orifice plate seating construction.



JORDAN CORPORATION

DIVISION OF OPW CORPORATION



6013 Wiehe Road Cincinnati 13, Ohio Elmhurst 1-1352

Representatives in principal cities.

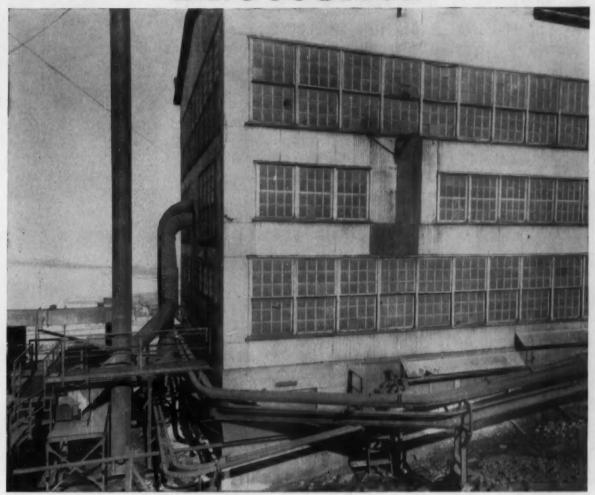


NO. 90 OPW-JORDAN PACKLESS SELF-CLOSING SLIDING GATE SAMPLING VALVE

Engineered for specific purpose of drawing off hazardous and volatile liquid samples for examination or laboratory test. Easy to operate, the No. 90 provides a convenient, accurate means of sampling liquids without danger to personnel, loss of product or damage to equipment. Write for Bulletin J-90

COME AND SEE US . . . AT THE NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING
NOVEMBER 26-30 • NEW YORK COLISEUM • BOOTHS 362 & 364

B.F.Goodrich



Rubber artery with a pounding pulse

A typical example of B. F. Goodrich improvement in rubber

Shooting through that long pipeline is hot, roasted molybdenum on its way to cooling tanks. It used to travel through iron pipes. But the lime in the mixture would stick to the metal, build up thick deposits, slow down the flow to a trickle. The plugged pipe had to be replaced at least once a year, sometimes more often.

When a B. F. Goodrich man heard of the problem, he suggested that rubber hose take the place of the troublesome pipe. He had in mind a B. F. Goodrich hose, made with a special rubber lining that resists acids and a tough rubber-and-fabric body to stand the pumping pressure. What's more, he knew this B. F. Goodrich hose would be flexible enough to expand and contract with the pump pressure, like a pulse beat in an artery, and so break off lime deposits as fast as they would form.

This B. F. Goodrich hose was tried, and worked perfectly. No reduction in flow whatsoever. In use almost continuously 24-hours-a-day, 7 days a week, the hose has outlasted pipe 10 to 1. There are even some lengths on this job after 15 years service!

Improvements are constantly being

made in all kinds of B. F. Goodrich hose to make them last longer, stand more abuse, handle easier, and cost less. Your B. F. Goodrich distributor is an expert at solving hose problems. Call him when you need help, or write B. F. Goodrich Industrial Products Co., Dept. M-741, Akron 18, Obio.

B.F.Goodrich

IN THE FIELD OF RADIATION SHIELDING...
WE HAVE SERVED INDUSTRY FOR OVER 35 YEARS



Lead Radiation Protection is our specialty.... manufactured and installed to suit the specific requirements of...

Recent Shielding

U. S. S. Nautilus

U. S. S. Seawolf

SIR Prototype West Milton, N. Y.

MARK 1 Prototype Arco, Idaho

ATOMIC ENERGY NUCLEAR INDUSTRIES HOT LABORATORIES INDUSTRIAL X-RAY ROOMS BIOLOGICAL SHIELDING

Stainless steel equipment of intricate design, fabricated to precise tolerances. Years of experience in the A. E. C. field enables us to meet your most rigid requirements...

VISIT US AT THE TRADE FAIR OF THE ATOMIC INDUSTRY CHICAGO, ILLINOIS - SEPTEMBER 24-28 BOOTH 122

o.c. KELLEY

and Company

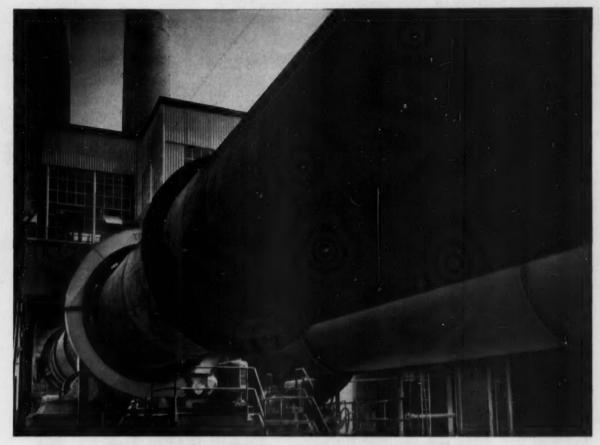
SHAINERES BESIGNESS FARRICATORS

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ISON CITY, TENN. ELIZABETH, N. J. CLEVELAND, OHIO NEW YORK, N. Y.

PITTSBURGH, PA.

HOUSTON, TEXAS



Almost 101/2 miles long

That's what it would take to equal the combined length of all the rotary kilns Traylor has built in the last 14 years. Built on the average of over 1 a month, more than 175 Traylor Rotary Kilns are currently engaged in the calcining, roasting and chloridizing, volatilizing, sintering and nodulizing of over 20 different products. Many of these are operating in the limestone and cement producing industries.

With this wealth of experience, Traylor has become thoroughly familiar with the thermo-processing requirements of modern limestone and cement production. Traylor has developed many advance rotary kiln design features that contribute to the low cost, trouble free calcining of lime and cement.

Every Traylor Rotary Kiln is individually "Traylor-Made" for its specific job. Sizes have

been built from the smallest up to 12' in diameter and 450' in length,

Bulletin #1115 will give you all the facts and information on the profit-producing advantages of Traylor Rotary Kilns, Write for your free copy today.

TRAYLOR ENGINEERING & MFG. CO.

SALES OFFICES: New York • Chicago • San Francisco CANADIAN MFR: Canadian Vickers, Ltd., Montreal, P. Q.



ROTARY KILNS















FIRST FOR LASTING QUALITY-FROM MINE TO MARKET!



For dependable "on-stream" performance . . . retube your exchangers with

PHELPS DODGE HEAT EXCHANGER TUBES!

Wide selection of copper-base alloys for every type of application—including bi-metal combinations.

Complete warehouse stocks maintained at Houston, Texas; Tulsa, Okla.; Los Angeles, Cal.; Chicago, Ill.; and Bayway, N. J.

Expert assistance in solving your tube corrosion problems.

Specify Phelps Dodge . . . One of the largest suppliers of tubes to manufacturers of heat exchangers!



PHELPS DODGE COPPER PRODUCTS

CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicage, Cincinnati, Cleveland, Dallas, Datrolt, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kanses City, Me., Los Angelss, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rachester, N. Y., San Francisco, St. Louis-Seattle, Washington, D. C.

extra fast delivery of standard Pfaudler glassed reactors new! SEE BACK COVER THIS ISSUE.

Pfaudler

Pfaudler Corrosioneering News Published by The Pfaudler Co., Rochester, N.Y..

ANNOUNCING PFAUDLER'S NEW



With Pfaudler's standard glassed steel polymerizers...

NO NEED TO SPEND OR TO WAIT FOR SPECIAL DESIGNS

Pfaudler now offers you four standard reactors—engineered to give you adaptability to a wide range of services.

Experience in the engineering of all types of polymerizers has led Pfaudler to incorporate the best features in standard designs. You can now save money by ordering a 2000- or 3700-gallon reactor rated for either 150 or 200 psi and get faster delivery than you could hope for with special designs.

You benefit in many ways when you install a standard glassed steel reactor:

Assures purity

Since resins will generally tolerate no contamination, all surfaces in contact with the product are non-metallic — almost entirely glassed steel. Glass cannot discolor products or act as a catalyst to inhibit polymerization! Accordingly it improves purity, uniformity, and yields.

Easy to clean

Synthetic resins, which may cling to even highly polished metals, usually will not adhere to the smooth, hard surface of glass. Cleaning, then, is simple and fast — Pfaudler's new Spray Rinse Valve does it thoroughly without opening the vessel. The agitator speeds emptying through the off-center bottom outlet. The outlet valve has a spray ring for cleaning this point.

Money saving feature

Glassed steel is a less costly material of construction than alloys. The saving is especially significant when high pressure construction is required. Furthermore, expense and delay in special designing are avoided.

Easy to operate

Pfaudler's new demountable blade agitator has made possible a series of design improvements which result in more convenient operation of the vessel. The blades can be removed without disturbing the drive. Need for a large cover has been eliminated. Accordingly, the manhole has been made larger and moved nearer to the side. The position of nozzles in the top head is likewise more convenient.

Sensitive temperature control

Each standard vessel has been de-

signed for rapid flow on both sides of the heat transfer surfaces. This and several other features make possible temperature control within ±1.0° F.

The Pfaudler agitative system furthermore produces thorough mixing—and has been specifically designed to give uniform resin particle size.

Pfaudler manufactures a variety of corrosion-resistant reactors, of course, as well as other equipment widely used in producing resins. If your process requires special engineering, Pfaudler can help you. But before you spend and wait for a special design, check to see if one of Pfaudler's standard polymerizers won't give you the adaptability you need.

Drop us a line and get more information about these standard reactors. Ask for Bulletin 932.

A new glassed steel autoclave

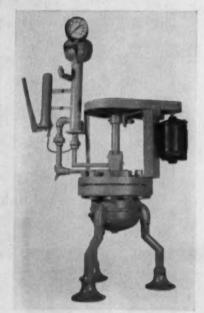
Handles reactions up to 750 psi

Your experiments with reactions involving high pressure and corrosive liquids have led to the development of a new, specially designed autoclave—now available to you at Pfaudler.

The new autoclave permits you to conduct reactions where internal pressures go as high as 750 psi with complete safety. Glassed steel construction prevents any undesired catalysis in the product from occurring. And you can study the reaction of highly corrosive liquids with the knowledge that no harm will come to the autoclave.

Since it is constructed of glassed carbon steel, the new autoclave gives you the corrosion resistance of glass and the structural strength necessary to withstand high pressures. Capacities are 1, 2, and 3 gallons.

You get a wide selection of agitation from the variable-speed drive the two-blade impeller agitator is glassed steel, too. Provision has been made for a thermometer well and



the nonmetallic rotary seal is equipped with pneumatic lubrication.

To find out more about these new autoclaves, write to us and ask for Bulletin 939.

Corrosioneering News

FILM-TYPE EVAPORATOR

You can uncover areas of greater profit with this simple-to-operate still

Pfaudler has added an important new member to its growing family of products - a wiped-film evaporator for vacuum distillation.

It is a new improved evaporator which offers low-cost development opportunities to many industries e.g. chemical process, food, pharmaceutical, plastics, petroleum.

A floating carbon blade acted upon by centrifugal force cleanly wipes the peripheral evaporating surface to promote a very thin film and tur-bulence-creating higher heat transfer rates and faster evaporation.

Here are the benefits you get from using the Pfaudler evaporator:

1. IMPROVED HEAT TRANSFER-Very high heat transfer rates even for highly viscous products due to turbulence pro-moting carbon blades.

2. SHORT CONTACT TIME—No deterioration for heat sensitive materials.

3. CONSTANT UNIFORM FILM — The walls are wiped by actual contact of the carbon blades. This is the only positive means of inducing controlled turbulence and uniform film thickness. Fouling and solids-build-up are eliminated.

A LOW-COST PROCESS—Because of the short contact time, high heat transfer rate and low power consumption of this evaporator, your operation can be more efficient and less costly.

 SPACE SAVING — An internal con-denser is built into the still eliminating an external condenser and interconnecting piping.

6. LOW MAINTENANCE RATE - Slow speed wiping minimizes wear. Closely ma-

chined tolerances between wall and wiper blades are not necessary because contact between the wiper and the wall is due to centrifugal force. Thermal expansion does not affect the operating efficiency of the wiper blades. No foot bearing is required.

7. LOW PRESSURE DROP - Pressure drops between evaporator and condenser as low as 1/10 mm Hg at one mm Hg operating pressure.

Two models available

Two Inch Laboratory Evaporator, complete with rotor motor, heating mantle, two 500-m.l. receiver flasks, batch-type feed flask, degasser, Teflon wipers, 24/40

(Prices on request.)

Units may be coupled for fractionation. The distributor acts to accelerate the distillate through the evaporator-residence time is less than one second.

In many installations of both the labo-ratory model and the Twelve Inch Pilot Plant unit, the versatility and high evaporation rate of this new evaporator have been proved. And it has been found that the quality of results from these small units can be dependably duplicated in production size units.



It's easy to test your distilland your-self with the laboratory model. Data you gather will enable you to uncover those areas of greater profit in your own operation. For your needs at that time, Pfaudler offers standard jacketed units in 24-, 36-, 48-, and 60-inch production size models.

Order the Pfaudler Two Inch Laboratory Evaporator now.

Corrosioneers make impartial selection of column material



Equipment users and fabricators alike often ask themselves: kind of a column is best here?

Users are in a position to be objective when deciding on one column or another. Pfaudler, too, calls on the same objectivity when planning

the fabrication of one column or another. Owing to their unique experi-ence with both glassed steel and alloy, Pfaudler engineers can make impartial selections of materials.

Careful evaluation is given to each column application. Here are the criteria Pfaudler uses:

- 1. Low cost and satisfactory corrosion resistance.
- 2. Easy handling, installation, and cleaning.
- 3. High vapor and liquid capacity.
- 4. Low vapor-pressure drop.
- 5. Top efficiency under high and low

loads and under mildly unsteady

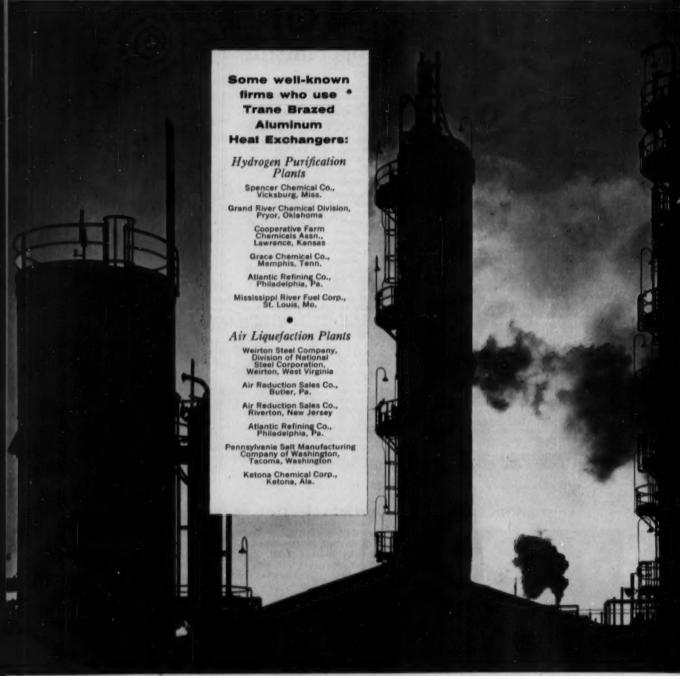
Proper balance of these conditions is your best guide to a good column purchase. That balance might come from a tray or packed column, a glassed steel or alloy column — Pfaudler's engineers are as impar-

tial in deciding as you are yourself! No matter what kind of a column application you're planning, you can be sure that Pfaudler will help you to select the right column.

For information on Pfaudler columns, ask for Bulletin 940 and Data Sheet No. 25.

Grace Chemical Company* reports . . .

5° F. temperature' with Trane Brazed Aluminum



This new Grace Chemical Ammonia Plant at Memphis, Tennessee is rated at 250 tons of anhydrous ammonia and 150 tons of urea per day. Plant engineering was done by Foster Wheeler Corporation, New York, N. Y. Nitrogen wash tower, the round structure at extreme left in above photo, contains six Trane Brazed Aluminum Heat Exchangers, with a total heat exchange surface of approximately 83,000 sq. ft. (See details in photo at right.)

approaches at -300° F. Heat Exchangers!

In new Memphis ammonia plant, exchangers cool hydrogen to -300°F. with -305°F. heat sink

At Grace Chemical Company's Memphis Ammonia Plant, engineers solved several low-temperature heat exchange problems with Trank Brazed Aluminum Heat Exchangers. Hydrogen-rich gas at 275 psig is cooled to -300° F. prior to liquid nitrogen scrubbing, which produces purified hydrogen for ammonia synthesis. After scrubbing, the hydrogen is returned to the cold side of the exchanger as the heat sink. Incoming nitrogen for scrubbing is liquefied by exchange with the liquid nitrogen bottoms from the scrubber.

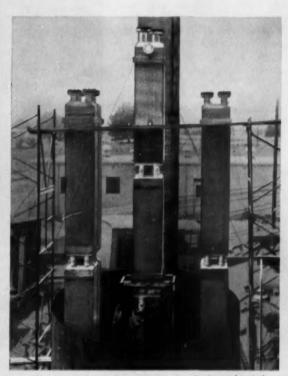
To handle these two heat exchange steps, engi-

To handle these two heat exchange steps, engineers of Foster Wheeler Corp., who designed the plant, turned to Trane Brazed Aluminum Heat Exchangers. One exchanger is used as a reboiler and two—with alternate operation connections—cool the incoming hydrogen. Pure nitrogen is passed through out-of-service exchanger to derime

it and to clear out accumulated solid CO₂. Switching over from one exchanger to another is accomplished with no interruption of production.

Trane Heat Exchangers were tested hydrostatically at 600 psig during fabrication. Helium leak tests under vacuum were also made. Units are operating as designed, with a 5° F. temperature difference between streams entering and leaving the cold end.

Many of today's most modern low temperature gas separation plants rely on efficient Trane Brazed Aluminum Heat Exchangers for cutting costs, maintaining highest production standards. If you have a heat transfer problem involving low temperatures, multi-stream operation or close approaches, turn to Trane! Thirty years of varied heat transfer experience is at your service. For more information, just contact your nearest Trane Sales Office—or write Trane, La Crosse, Wis.



Two switch exchangers and reboiler, shown here during installation in the nitrogen wash tower, consist of TRANE brazed aluminum cores of corrugated plate fin design. Operation is at approximately 275 psig. Temperatures range from 50° F. to -300° F. with a 5° F. difference between streams entering and leaving the cold end.

For heating, cooling, ventilating...

For any air condition, turn to

TRANE

MANUFACTURING ENGINEERS

TRANE COMPANY OF CANADA, LTB., TORONTO . BO U.S., AND IS CANADIAN OFFICE!



TRANE Brazed Aluminum Exchangers, either individual cores or multi-core assemblies, as shown above, can be headered for multi-stream operation combining as many as four different heat exchangers in one unit. Inherent properties of aluminum and unique design make these exchangers ideal for low temperature application used in gas separation plants.

PYREX® pipe proves its corrosion resistance...

in process that chewed through other pipe

Rugged glass gentles savage acids; cuts maintenance, improves production and purity

If you have a critical pipeline corrosion problem, you may be having the same kind of troubles this plant did until 1950.

Until then, the chlorinated rubber unit of the Parlin, N. J. plant of Hercules Powder Company, was resigned to the shortcomings of pipe that couldn't stand up to the corrosion of their process. One kind of pipe Hercules used was not fully corrosion resistant to the chlorine compounds it carried. Moreover, it was heavy, requiring extra support; and difficult to align.

Another pre-1950 pipe was lighter but deteriorated rapidly under the flow. The resulting product impurity and the danger of gas leaks were serious—and expensive—because they caused frequent production slow-down for repairs.

Experiment pays off

In 1949, Hercules installed test lines of Pyrex brand glass pipe. Officials concluded that Pyrex pipe was superior to any other on the market for this application. In 1950-51, all other lines handling corrosives were replaced with Pyrex pipe.

After five years in this service, glass pipe

shows no sign of corrosion. Its completely inert quality renders it impervious to the attack of the heavily acid formula.

The light weight of the pipe enabled Hercules to make a satisfactory installation which involved proper alignment and support. And, while the transparency of glass was not a buying factor originally, visibility has become valuable. Operators check flow continuously for bubbles, cloudiness, the presence of liquid when gas is expected, and other irregularities.

PYREX pipe will help you

There's nothing unusual in this case history. PYREX pipe performs feats of corrosion resistance, purity protection and trouble elimination in hundreds of chemical plants.

No matter what corrosive you handle, except HF and hot concentrated alkalies, you can get the same high-level freedom from trouble with PYREX pipe.

Please let us help you eliminate your corrosion problem. The coupon will bring informative literature, and if you wish, a representative to give you a personal evaluation of your problem. Send it today.



Parlon, Hercules Pewder Company's chlorinated rubber, is a film-forming material that's unaffected by acids, alkalies, salts, moisture and fungus. It's used as a base for maintenance and corrosion resistant commercial and industrial paints.



Installation of PYREX pipe is easy for your own pipe filters to do, even if they've never worked with glass before. Plant employees do all Hercules' installation, maintenance.



Section of 2,300-foot PYREX pipe installation (some is armored). Parlon process consists first of cooking, washing, drying rubber. Then it's dissolved in carbon tetrachloride. Solution goes to chlorinators for chlorine addition, is then filtered and sent to precipitators. After further purification, washing, blending, product is complete. Glass pipe used exclusively.



City ...



CORNING GLASS WORKS 19 Crystal Street, Corning, N.Y.

Corning means research in Glass

CORNING GLASS WORKS, 19 Crystal Street, Corning, N.Y.

Please send me a copy of Bulletin EA-1: "PYREX brand Glass Pipe in the Process Industries" [], I would like your representative to telephone for an appointment [].

Nome	Title
Company	
Street	

Zone....

CHEMICAL ENGINEERING—September 1956



NEW

silicone defoamer gives you the ultimate in foam-killing convenience

ANTIFOAM B

FAST ACTING New Dow Corning Antifoam B disperses immediately in aqueous solutions. No stirring or agitation required.

READY TO USE Just add "as is" . . . No delays for diluting or mixing. No need for extra containers.

LASTS LONGER Will not oil out, plate out, settle or precipitate in most applications. Ideal for continuous processing.

STABLE Long storage life — stays uniform even if frozen or boiled. Retains effectiveness after sterilization.

TEST

ANTIFOAM B AT

Write, wire or phone today for a generous FREE SAMPLE and full particulars . . .

first in silicones

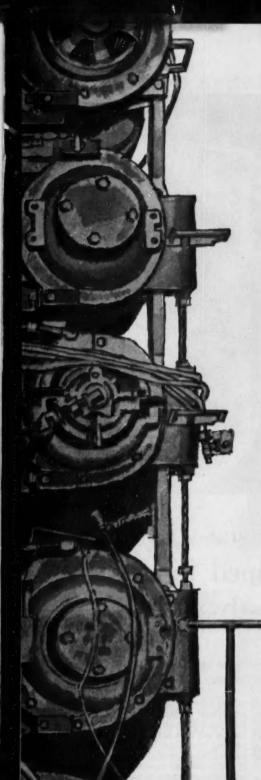
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DOW CORNING CORPORATION
Midland, Michigan

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS GETROIT LOS ANGELES NEW YORK WASHINGTON, D. C., (DILVER SPRING, HD.)

CARABA: GOW CORNING SILICONES LTD., TORONTO GREAT SERTAM: MIDLAND SILICONES LTD., LONDON FRANCE: 87, COSAIN, PARIS



To the mill executive who decides on lubricants-

Three good reasons for specifying STANOIL Industrial Oil

The increased demand for paper products results in machinery being operated at speeds higher than rated capacity. Continuous production has placed greater burdens on lubricating oils. Without the best lubrication, equipment failures may occur. Best idea is to specify Stanoil. Industrial Oil.

2 Cost of repairs and replacement of parts added to the loss of production, run many times the cost of lubrication. A small investment in Stanon. Industrial Oil is the best possible protection against bearing failures, repair costs and production loss.

3 STANOIL Industrial Oil can be used in a multitude of applications. Inventories of lubricants can thus be reduced and the danger of lubrication failure due to misapplication can be cut or even eliminated.

Get more facts about STANOIL from your nearby Standard Oil lubrication specialist. There is one near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Quick Facts About STANOIL Industrial Oil

- Stability—STANOIL's antioxidant gives oil resistance to chemical change, minimizes deposits.
- Rust Prevention—Inhibitor in STANOIL "plates out" on metal surfaces, prevents corrosion.
- Cold Starts—STANOIL has low pour point. Flows freely from cold start. No need for costly warm ups.
- Resists Effects of Temperature Change—STANOIL has high viscosity index, is resistant to temperature change. Lubricates in both high and low temperature service.
- Has Excellent Demulsibility— STANOIL is refined to eliminate emulsion problems, contains additive to minimize foaming.

STANDARD OIL COMPANY

(Indiana)







Saran lined pipe to saran valves. Notice the saran lining is continuous.

Saran Lined Pipe Company 2415 Burdette Avenue Ferndale, Michigen Dept. SP-628A-1	The second second
Please send me informatio and valves.	n on seron lined pipe, fittings
Name	Title
Семрелу	
Address	V-II
City	Stote

Saran Linod Pipe is Manufactured by The Dow Chemical Company, Midland, Michigan

You can see why Saran Lined Pipe eliminates costly downtime

Corrosive liquids can't touch the strong steel pipe
... even at fittings...it's lined continuously with thick, durable saran

Saran lined pipe, fittings and valves convey acids, alkalies and many other corrosive liquids for years with trouble-free performance. One chemical manufacturer reports a saran lined pipe installation used intermittently for ten years with no corrosion shutdowns. Similar reports came from the petroleum waste, pulp and paper, metal finishing and food processing industries.

Saran lined pipe is made of corrosionresistant saran swaged into rigid steel pipe. Saran lined pipe, fittings and valves form snug, tight-fitting, leak-proof joints... is available for working pressures up to 150 psi. Valves and fittings are also available in steel for working pressures to 300 psi. This modern piping is easily installed, too. It can be cut and threaded in the field with available pipe fitters' tools. Its rigidity means few supporting structures are needed. For further information on saran lined pipe, fittings and valves, send in the coupon on the left. THE DOW CHEMICAL COMPANY, Midland, Michigan.

you can depend on DOW PLASTICS



These are New Standard POWERSTAT* VARIABLE TRANSFORMERS

The most extensive line of variable transformers is POWERSTAT. Only the POWERSTAT line offers the innumerable standard air-cooled types for manually-operated or motor-driven duty; the oil-cooled models; the explosion-proof units. Your "special" requirement for variable a-c voltage control equipment generally can be satisfied with a standard POWERSTAT variable transformer. Look to POWERSTAT for the complete line of variable transformers of the highest quality . . . designed, engineered and manufactured to provide long, dependable service. Check over the features of these new standard POWERSTATS.

360° ROTATION



TYPE 10-1002 — With complete rotation; this compact unit is ideal for servo-mechanisms and temperature regulators. INPUT: 120 volts, 50/60 cycles, single phase OUTPUT: 0-120 volts, 1.25 amperes, 150 VA

PILOT LIGHT

TYPE 116-1005 - A POWERSTAT of 1 KVA capacity with pilot light to indicate when unit is energized. INPUT: 120 volts, 50/60 cycles, single phase OUTPUT: 0-140 volts, 7.5 amperes, 1.0 KVA



MOTOR DRIVEN For 50 or 60 Cycles



TYPE 116-1004 — A motor-driven assembly of 1 KVA capacity featuring rapid control and silent operation for use on 50 INPUT: 120 volts, 50/60 cycles, single phase OUTPUT: 0-140 volts, 7.5 amperes, 1.0 KVA

DUST PROOF CONTAINER

TYPE 1126-1001—For high frequency applications — supplied in dust proof container with AN connector and screw-INPUT: 115 volts, 400/800 cycles, single phase driver slot control with locking device. OUTPUT: 0-130 volts, 15.0 amperes, 1.95 KVA



FOR TEMPERATURE CONTROL



*Trade Mark Reg. U.S. Pat. Off.

Branch Offices et: 14663 Titus St., Van Nuys, California . P. O. Box 946, 2881 El Camino Real, Redwood City, California + 482-8 Eglinton Ave., West, Toronto 12, Ontario, Canada + 2217 Biscayne Blvd., Miami 37, Florida . P. O. Box 48, 721 So. Blvd., Oak Park, Illinois . 4033 W. Rogers Ave., Office #2, Tippett Bidg., Baltimore 15, Maryland . 250 Park Ave., Rms. 502-504, Postum Bldg., New York 17, N. Y. P. O. Box 132, 101 Public Sq., Medina, Ohio • 4515 Prentice St., Room 201, Dallas 6, Texas 839 Central Bldg., 810 Third Ave., Seattle 4, Washington. TYPE 136-1003 - A motor-driven unit with potentiometer on shaft for temperature control applications using electric proportional control. INPUT: 240 volts, 60 cycles, single phase OUTPUT: 0-240/280 volts, 20 amperes, 5.6 KVA

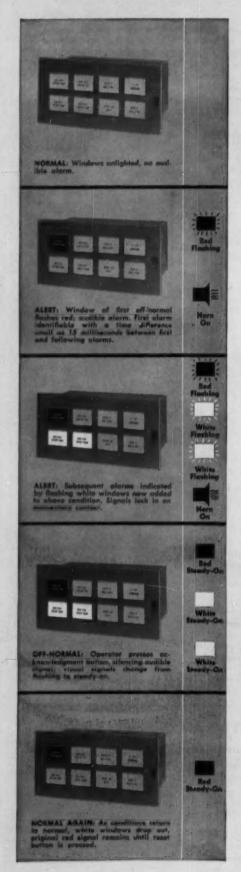
See Superior Electric's Mobile Display when it is in your area.

THE SUPERIOR ELECTRIC

1409 MIDDLE STREET, BRISTOL, CONNECTICUT

Please send me literature on POWERSTAT variable transformers Please have representative call Name

Company.



Panalarm "VS" Annunciator identifies <u>first</u> off-normal from subsequent alarms for rapid corrective action

You gain the control advantages of an audio-visual information system, not just an alarm system, with the Panalarm "50VS" Visual Sequence Annunciator. This is particularly valuable when one off-normal condition will cause a "chain-reaction" of off-normals. Typical Panalarm applications are found in the process industries and among users of automatic machinery.

The original off-normal is clearly identified, enabling the operator to take immediate, corrective action. A considerable saving in down-time can often be effected simply by knowing the original source of trouble.

Panalarm "50VS" is completely flexible in setting up various sequential groups. Any number or combination of signals may be grouped as an independent sequence, and the groupings may be changed at any time by simple jumpers on the terminal block. Signals may be either illuminated nameplate or bullseye indicators, combined with a horn, bell or other audible signal. Signaling is simple and positive. A typical sequence is illustrated on the left.

Write for literature on the "50VS" and other Panalarm Annunciator Systems. A Panellit sales engineer will be happy to make a survey of your production operation to determine whether a Panalarm system can help increase efficiency and safety in your plant.

All Panalarm Annunciator Systems are completely modular, permitting future growth and changes. The photographs below illustrate a typical Panalarm Cabinet with illuminated nameplates and the hermetically sealed Panalarm "50" plug-in relay unit. Components throughout are ruggedly built to instrument standards for continuous, dependable duty. Entire Panalarm system is suitable for Class 1, Division 2 installations.



Listed by Underwriters' Laboratories



U.S. Patent No. Re-24,031

Engineered Information Systems for Industry



Graphic Panels Central Centers

Panalog

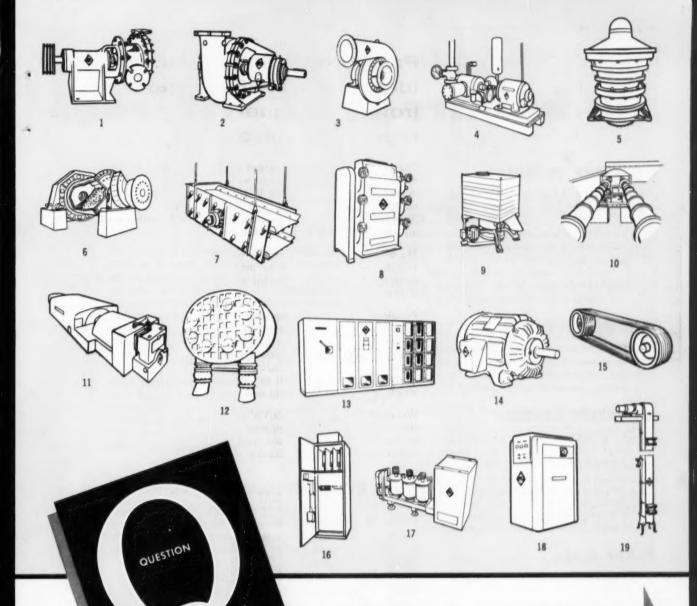


Instrument

PANALARM

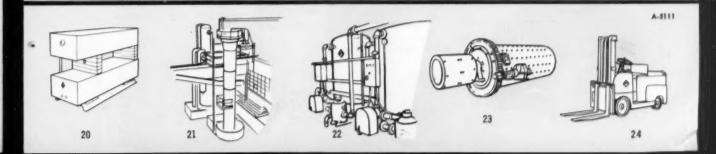
PANELLIT, INC.

7413 N. Hamlin Ave. Skokle, III. Panellit of Canada Ltd. Teresto 14



... What single manufacturer builds all this equipment

for the CHEMICAL PROCESSING INDUSTRIES?



Improve Product Quality, Streamline Production,

in hundreds of different

GYRATORY CRUSHERS

"One-man, one-minute" product control, a feature of Allis-Chalmers primary, secondary and tertiary gyratory crushers, slashes setting changing time from hours to seconds. Size adjustment, compensation for wear and emergency unloading are accomplished by the flick of a switch.

Other A-C crushers include complete size ranges in five types of jaw crushers, a line of roll crushers and an impact hammermill.

GRINDING MILLS

Whether your process calls for individual mills or a grouped stage grinding series, Allis-Chalmers can make a right-for-the-job recommendation from seven different types of grinding mills.

VIBRATING SCREENS

Allis-Chalmers vibrating screens are built in single and multiple-deck models for use in scalping, wet or dry sizing, washing, rinsing, dewatering, and media recovery. Auxiliaries or modifications include step decks, pool washing decks, heat expanding decks, decks designed to prevent blinding, special dust enclosures, water-cooled mechanisms, automatic stop control.

BLADE MILLS

Designed for large tonnages of hard-to-wash materials, blade mills effectively disintegrate and wash into suspension tenacious clays and other unwanted substances.

CENTRIFUGAL PUMPS

More than 60 years' experience in designing centrifugal pumps goes to work for you when you specify Allis-Chalmers. The line includes process and solids handling pumps as well as general purpose types.

ROTARY KILNS

All welded, one-plate-to-a-circle construction, patented heat recuperation, effective air seals, centralized control, air-cooled feed and discharge ends — these are some of the many improvements engineered by Allis-Chalmers that make the rotary kiln the most efficient method of pyro-processing.

ROTARY DRYER-COOLER

This versatile equipment is particularly applicable in drying or cooling heavy or high moisture content materials. It dries with a parallel flow and cools with a counterflow. Available in direct, indirect, or direct-indirect types. Allis-Chalmers also builds tube-type rotary coolers and air-quenching grate coolers.

GYRATORY SCREENS

All-metal unit is designed to separate dry granular materials into two, three and four predetermined sizes. Stacked sieve design facilitates quick product change-over and simplified sanitation.

COMPACTING MILLS

Used to produce paper-thin flakes or to increase the apparent density of your product. There's an Allis-Chalmers mill specifically designed to handle a wide variety of grinding, crushing, rolling or compacting jobs in the chemical processing industries.

... all completely integrated with the required electrical equipment.







Incr



ALLIS-CHALMERS

... manufactures the most complete and diversified lines of equipment for unit operations

Allis-Chalmers builds equipment for liquid handling, air and gas handling, size reduction, wet and dry screening, washing, pyro-processing, materials handling. Equipment recommendations are based on the coordinated thinking and planning of various engineering groups at Allis-Chalmers. This unique service "teams up" new equipment with existing equipment in your operation. Electrical equipment, too, is integrated into each process. Responsibility for efficient operation rests with just one manufacturer—a big advantage.

There's No Guesswork

In working with your staff or consultants, your A-C representative uses the technical skill and

experience of the many Allis-Chalmers engineering departments. Their recommendations are backed by research, by testing and pilot plant facilities, by the "know-how" gained in solving thousands of equipment application and coordination problems.

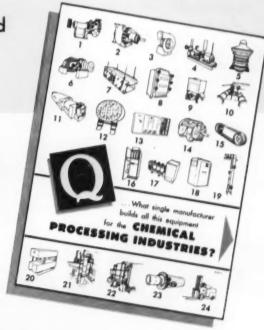
Unbiased Recommendations

Because Allis-Chalmers builds many types and sizes in a given line, equipment selection is dictated only by your specific needs.

Most important is the fact that Allis-Chalmers interest in your problem does not stop when your equipment is installed. Periodic check-ups, maintenance and technical advice, fast emergency parts service, are yours continuously.

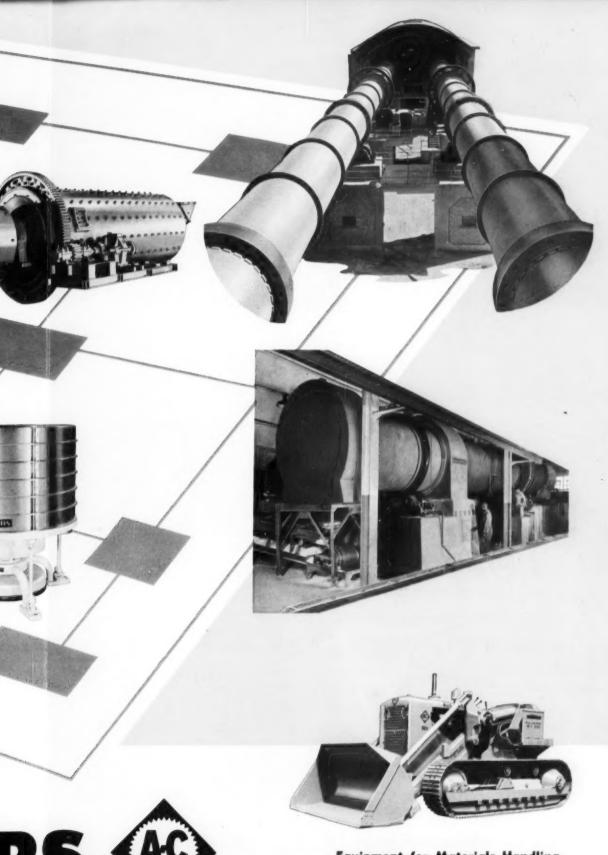
How many pieces of Allis-Chalmers equipment did you identify in the cover illustration?

1. Process Pump; 2. Solids Handling Pump;
3. Centrifugal Blower; 4. Rotary Compressor; 5.
Gyratory Crusher; 6. Grinding Mill; 7. Vibrating
Screen; 8. Roller Mill; 9. Gyratory Screen; 10.
Rotary Kiln; 11. Turbine Generator; 12. Condenser; 13. Unit Substation; 14. Explosion-Proof
Motor; 15. V-belt Drive; 16. Motor Control; 17.
Mercury Arc Rectifier; 18. Dielectric Heater; 19.
Manlift; 20. Metal Detector; 21. Continuous
Contact Column (for liquid-solids separation); 22.
Water Conditioning Equipment; 23. Blade Washer; 24. Lift Truck.



Increase Profits... perations

ALLIS-CHALME



RS



Equipment for Materials Handling

Thousands of world famous Allis-Chalmers tractors, tractor shovels, lift trucks, bulldozers and scrapers are working indoors and out in the chemical processing industries.



Incr

... manufactures the most complete and diversified lines of equipment for unit operations

Allis-Chalmers builds equipment for liquid handling, air and gas handling, size reduction, wet and dry screening, washing, pyro-processing, materials handling. Equipment recommendations are based on the coordinated thinking and planning of various engineering groups at Allis-Chalmers. This unique service "teams up" new equipment with existing equipment in your operation. Electrical equipment, too, is integrated into each process. Responsibility for efficient operation rests with just one manufacturer—a big advantage.

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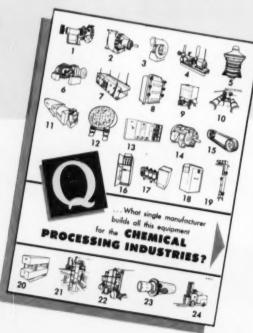
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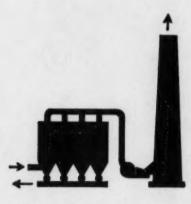
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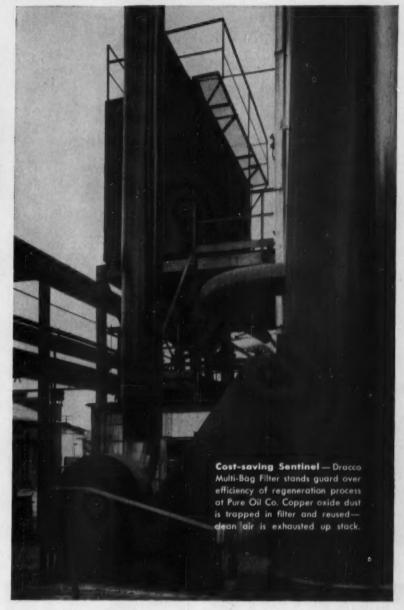
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DRACCO RECOVERY SYSTEM AT REFINERY MEANS:

pure air, sure savings for Pure Oil



At its Toledo refinery, Pure Oil Co. has halted escaping dust from a copper oxide regeneration process with Dracco Dust Control equipment. This dust problem was a costly nuisance—wasting valuable chemicals and causing undesirable working conditions.

Pure uses a cupric oxide for sulfur removal during refining of naphthas. Regenerating the spent cupric sulfide back to the oxide requires roasting, grinding and handling operations.

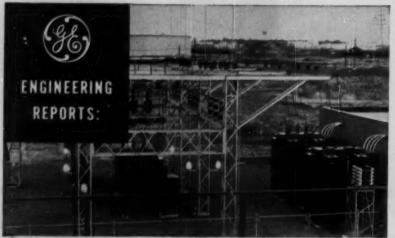
Dust is now trapped at multiple sources and recovered at 99½-100% efficiency in a Dracco Multi-Bag Filter. The system operates 24 hours a day, exhausting clean air with no visible dust. Savings are realized by returning

collected copper oxide to process.

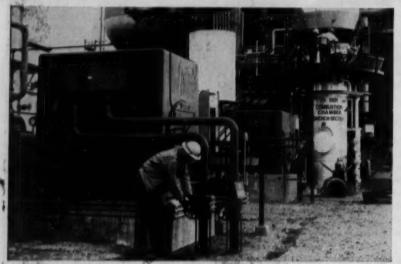
For Pure Oil Co., Dracco Dust Control now means pure air and cost savings. For your plant, a custom-engineered Dracco system can provide similar advantages. Why not call or write Dracco today?

DRACCO CORPORATION
4040 East 116th Street • Cleveland 5, Ohio

Bulletin 800 is Dracco's 40-page eatalog on dust control and recovery. Contains detailed facts and figures on all dust control equipment. For your copy, write Dracco today. Airstream CONVEYORS . DUST CONTROL EQUIPMENT



EASY EXPANSION was provided during planning stages of SOHIO system. For example, each of two 11,500-kva power transformers on General Electric package substation, providing 4160 v for plant distribution, can be uprated to 14,394 kva.



DESIGNED for outdoor process use, two General Electric totally enclosed, inert-gasfilled induction motors, with gas to water heat exchangers, drive centrifugal blowers. Total connected load of the plant's motors approximates 25,000 hp.



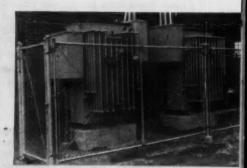
OVER CURRENT and short circuit protection is provided for 175 through 1000-hp motors by 4160-v Limitamp* controllers.



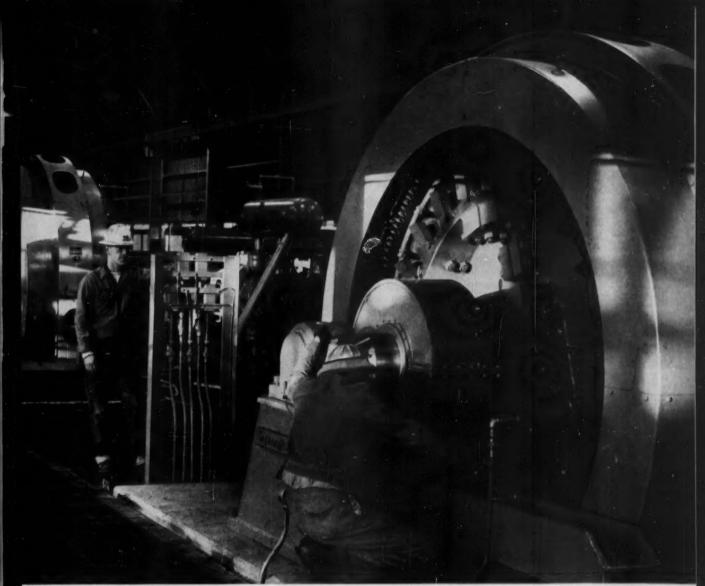
COST SAVING load center system brings higher voltages closer to load. Low voltage switchgear controls auxiliary motors.



Here's how system



SYSTEM PROTECTION through neutral — grounding covers all voltage levels, including 1000-kva medium transformers.



PRESSURIZED HOUSING encloses aliprings of two 3000-hp General Electric synchronous motors driving synthesis gas

compressors. Secondary selective system helps permit almost all motors in the system to have a standby power source.

SOHIO Chemical's engineered electrical helps prevent lost production

General Electric engineered system at new Lima, Ohio, petrochemical plant was planned for reliability, future expansion.

The SOHIO Chemical Company operates their new \$17,000,000 petrochemical plant with a General Electric engineered electrical system planned and installed to meet present and future electrical requirements. This modern plant, designed to produce 300 tons of anhydrous ammonia per day, was engineered and constructed by The M. W. Kellogg Co., New York.

2 BASIC REQUIREMENTS were set forth by SOHIO...
(1) reliability to help guard against lost production and
(2) flexibility for future expansion. General Electric engineers worked closely with SOHIO personnel and

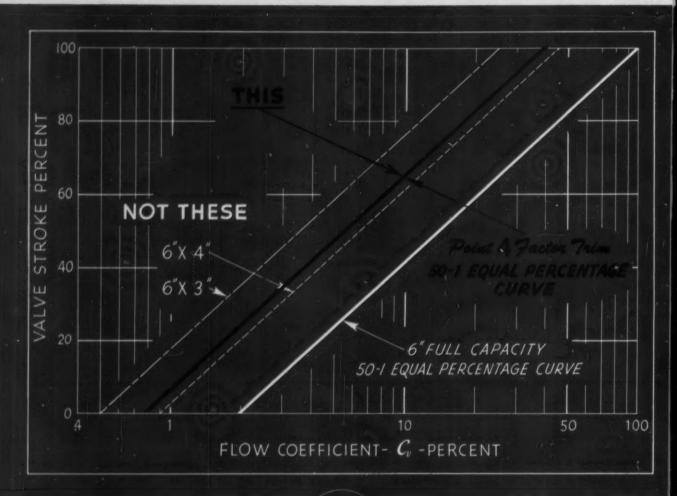
their consultants to gain these objectives. On these pages are some highlights of the system.

WHEN YOU BUILD, or modernize, take advantage of General Electric quality-engineered electrical equipment and complete engineering services for the chemical industry. Your General Electric Apparatus Sales Representatives at the nearest G-E Apparatus Sales Office will give you complete information. Contact him early in your planning and write for bulletin GED-2244 "Engineering Services" to General Electric Co., Section 681-13, Schenectady, New York.

Engineered Electrical Systems for the Chemical Industry

GENERAL & ELECTRIC

One Size...





Point 4 Factor Trim

is the answer to those few types of applications where reduced capacity trim is required. It is available in V-port and solid turned designs for double or single seated valves and in a wide variety of materials. Send for Data Sheet No. 10-5.

Not Two

Masoneilan Point 4 Factor 7rim offers the ONLY REALISTIC approach to selection of reduced capacity trim

It is a DEMONSTRABLE Fact that for a given size top-and-bottom guided valve only one size reduced capacity trim is:

Desirable from an engineering standpoint because . . .

- (a) properly designed wide-range valves with full capacity trim will handle a vast majority of control problems.
- (b) if any reduction is required, it must be substantial to be of any advantage.
- (c) any sound design must be based on a reduction in seat ring diameter.
- (d) rule-of-thumb trim reductions

based on nominal pipe sizes are unnecessary and merely complicate the sizing problem.

Practical from manufacturing and operating standpoint because . . .

- (a) mechanical strength is retained with standard guide and stem diameters and standard stroke, in combination with maximum reduction in seat diameter.
- (b) reduction in number of parts simplifles stock problem.
 - (c) forged and cast forms insure complete uniformity of parts.

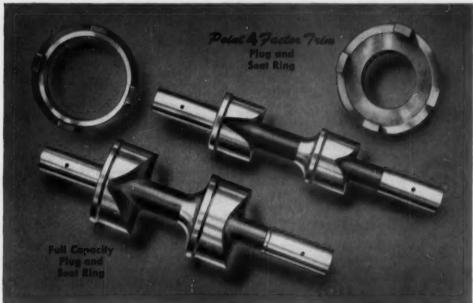
MASON - NEILAN

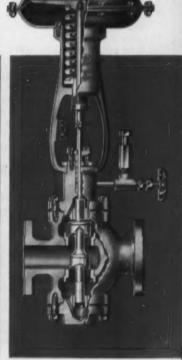
MASONEILAN

Division of Worthington Corporation

67 NAHATAN STREET, NORWOOD, MASSACHUSETTS

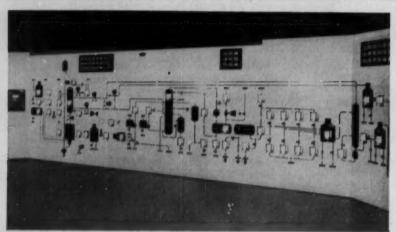
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New Orleans • Dallas • Seattle • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto





BRISTOL'S INSTRUMENTATION

News and information about automatic controlling, recording and telemetering



TYPICAL GRAPHIC PANEL of Bristol Metagraphic instruments in oil refinery. Panel designed by The Fluor Corporation and built by Panellit Inc.

New design freedom for systems engineers! A fully flexible plug-in, functional-unit system, Bristol Metagraphic instrumentation is easiest to plan, install, operate and service

A new concept in automatic control and instrumentation, Bristol's Metagraphic instruments are installed as a three part system with transmitters, receivers, and automatic controllers completely independent of each other except for connection through a universal 3-15 psi pneumatic signal.

This functionally designed unit system allows a new degree of freedom from pre-installation decisions by the installing and planning engineers. Changes in instrument layout and control actions can be accomplished in an absolute minimum of time and cost.

Transmitters for every variable

Metagraphic transmitters are available for measuring temperature, flow, liquid level, pressure, absolute pressure, differential pressure and mechanical motion.

The transmitter converts the measurement into a universal 3-15 psi signal, proportional to the measured variable, and sends it to an indicating or recording receiver or an automatic controller.

Calibrated simply in terms of 3-15 psi air pressure; Metagraphic receivers and controllers thus are independent of the actual variable being measured by the transmitter and can be used with equal accuracy to indicate, record or control any of the variables that the different transmittegs are capable of measuring.

Metagraphic transmitters are available in a variety of ranges and spans—easily field-adjusted—many with over-range protection to 400%. Their high air output (3cfm) means better recording and control in any application.

Choice of 34 automatic controllers

Bristol Metagraphic controllers are available in 34 different models to suit every need. Yet almost complete interchangeability between models is possible.

Full-plug-in construction allows easy change of control mode or service, and practically eliminates down time for maintenance.

Controllers may be receiver-, pipe-, or surface-mounted plug-in type or pipe-connected. Remote or integral set-point types (with or without air loading) are available.

Five modes of centrol action: On-off, adjustable proportional, adjustable proportional plus reset, fixed proportional plus reset, and proportional plus reset plus derivative (rate).

Quick-change receivers in 35 models

With 35 models to choose from, and full plug-in construction available, Bristol's Metagraphic receivers give you unmatched flexibility in operation.

You can change from a recorder to an indicator or vice versa in 10 seconds. If trouble is suspected, the receiver can be replaced to eliminate down time while it's checked in the shop. There's absolutely no interruption of automatic control since the receiver is outside the control loop.

And . . . check these features :

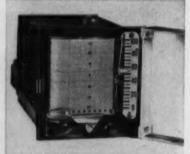
Continuous valve position indication is on same scale as set point. Simply match pointers to achieve "bumpless transfer." No need to read scales.

High-visibility colored fluorescent paints make pointers easy to identify.

Air chart drives are 100% pneumatic (operating from 20 psi supply). No electricity required.

Universal piping manifold can be adapted to any piping system (2-pipe or 4-pipe). No special tools or parts required.

Write for complete data on versatile Bristol Metagraphic instruments for your control, recording or indicating needs.



BRISTOL TWO-PEN metagraphic recording receiver.

Two-pen receiver keeps tabs on four variables

One of the 35 Bristol Metagraphic receiver models available, the two-pen recording receiver records, indicates and controls one measured variable, records one related variable on the same chart and gives a continuous indication of either set point or valve position—whichever is desired.

If valve position is chosen to be continuously indicated, the set point may be indicated at any time by depressing the valve knob. Similarly, if set point is continuously indicated, depressing the knob indicates volve position.

The two-pen recording receiver has the easy readability, compact construction, and plug-in flexibility that characterize all Bristol Metagraphic instruments. It's available with manual-automatic station or sixposition transfer valve for cascade control.

Write for complete technical data on this versatile pneumatic recording receiver.

NEWS AND NOTES

instruments from Bristol . . . leaders in human-engineered instrumentation

*

A-subs hot-but under good control

Construction of the hulls for atomic submarines, Nautilus and Seawolf, probably represents the most massive, elaborate, and radically different welding and hull-rolling job ever attempted.

Built by General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, the subs are constructed from short circular sections (like pipe sections). These sections are welded together around their circumference to form the cigar-shaped hull.

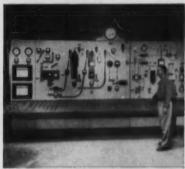
Before welding, the area immediately adjacent to the welds is preheated with induction coils wrapped around adjacent ends of the sections to be welded. Bristol Dynamaster pyrometers precisely control the heat produced by these coils.

When preheated to the proper tem-

perature, the sections are "hull-rolled" while stationary welding machines make the weld at constantly controlled temperatures. After welding is completed, the Dynamaster-controlled induction coils maintain the area around the weld at a uniformly decreasing temperature to insure cooling with maximum strength and toughness.

It takes days to complete the preheating, welding, and cooling for a single hull-section pair. Throughout this period the Dynamaster pyrometers keep the hull temperature at the design value, despite widely varying atmospheric conditions.

Want to find out more about Bristol Dynamaster pyrometers for your temperature control job, large or small? Write for Bulletin P1245A.



GRAPHIC PANEL at Central Soya Company's plant at Chattanooga, Tennessee.

Bristol instruments help process Soy Beans

Centralized control of a soy-bean oil extraction plant is the function of this graphic instrument panel, installed at the Chattanooga, Tennessee, plant of the Central Soya Company.

Multiple-point Bristol Dynamaster and Metagraphic recorders monitor temperatures and pressures throughout the process, as well as plant power consumption and steam pressure. Ammeters on the panel show current drawn by equipment and conveyor motors. Control switches and running lights are located on the desk surface at front of panel.

One compelling advantage of this graphic panel instrumentation system is that it safely and conveniently shows both management and operating personnel the whole operation. Quality control is greatly facilitated; system upsets may be analyzed and corrected before the final product is affected. This over-all picture is otherwise very difficult to get since the process occupies a building four stories in height that has floor levels made of steel gratings.



Special receivers simplify cascade control

Bristol's Metagraphic receivers for cascade control are offered in a wider variety of models than any similar competitive instrument.

The cascade receiver (or "slave" receiver) is available as a one or two-pen recorder or a one- or two-pointer indicator, or a one-pen, one-pointer model. The two-pen recorder is unique with Bristol With it, the master controller measurement can be recorded on the same chart as the slave controller record, thus placing both related variables on the same chart. Another, related variable can be recorded in place of the master-controller variable, of course.

One big advantage of Metagraphic cascade control over other similar receivers is the six-position transfer valve, on one knob. Most other models require two knobs, and pointers on two scales in order to achieve bumpless transfer. With Bristol's six-position model you just match pointers on the same scale, and switch over.



SIX-POSITION TRANSFER VALVE on one knob for cascade control.

OUR ENGINEERS . . .

will be glad to discuss your specific instrumentation or control problem with you. Or, write for complete technical data on any of the instruments mentioned on these pages. The Bristol Company, 109 Bristol Road, Waterbury, Conn.

6.21

WHAT'S NEWS AT BRISTOL . . . WHAT'S NEWS AT BRISTOL . . .

Then it comes to "bottles

B&W Banded Vessels offer solid inner shell and head construction, designed, built and tested to withstand greater longitudinal stress or end thrust than is required for any specific application. This type of construction permits minimum critical welds.

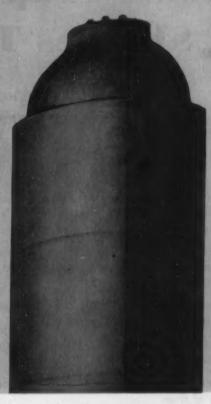
Combined with stress relieving and full X-raying, it all adds up to proven reliability, as B&W Banded Vessels have long demonstrated in service.

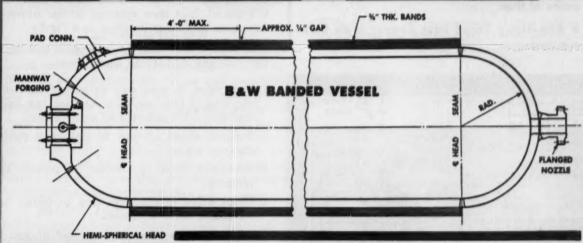
B&W Pressure Vessels can be supplied in sizes from 50 to 10,000 gallons and for pressures to more than 6,000 psi. The Babcock & Wilcox Company, Process Equipment Dept., Barberton, Ohio.





consider longitude al diress





Alloy cladding is another B&W plus value. Where specified, B&W Croloy-Cladding is electrically bonded to the inside surface of the base plate for dependable, lasting protection against corrosion.

CLADDING ELECTRICALLY
BONDED TO BASE METAL
INSIDE SURFACE
E MAX.

BASE METAL

BAW CLADDING

Steam Trap Standardization Slashes Trapping Costs

Major User Reports \$25,000 Annual
Maintenance Saving with 4000 Armstrong Traps

Here are the Benefits

- Quick Replacement of Traps simply by uncoupling unions and installing a "spare" trap complete with nipples and half unions.
- Bypasses Not Needed—drain line can be shut off during quick trap replacement, even on critical equipment.
- Repair Parts Inventory Reduced by standardization on one make of trap.
- Purchasing Simplified through standardization.
- Maintenance Men Become Experts on one make of trap.
- Armstrong Traps Last Longer with less maintenance.

MAJOR REDUCTIONS in steam trap installation and maintenance work and cost can be achieved by standardization on one make of trap which, in turn, permits standardized hookups. For example, a major chemical company reports an annual maintenance saving of \$25,000 since installing 4000 Armstrong traps according to the drawing and photographs shown here.

Traps of a Size Interchangeable

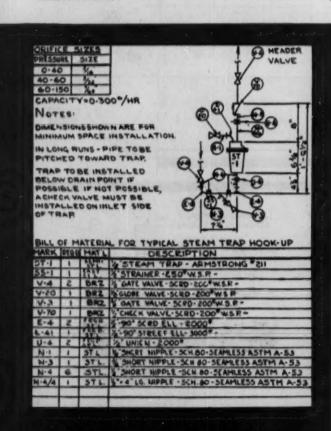
Note particularly that exact dimensions are given for the pipe fittings, including nipples, connected to each size of trap. When a trap needs repair, the unions can be uncoupled, the trap lifted from the line, and a "spare" carrying indentical length nipples and half-unions slipped in place. Thus, in as little as one or two minutes, a faulty trap is replaced. It is then returned to the storeroom for repair and takes its place as a "spare."

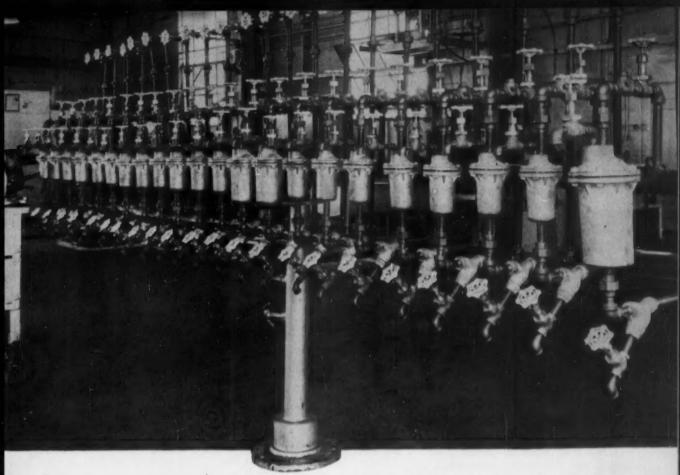
Additionally, each trap hookup offers the following time and cost-saving advantages:

- 1. Test valve in trap cap to permit fast, easy checking of trap operation so that any failure can be quickly detected to avoid waste.
- 2. Strainer ahead of trap to protect it against dirt and scale.
- Blowdown valve in strainer to provide easy cleaning.
- 4. Check valve in discharge line to isolate trap when test valve is opened.
- Shut-off valves and unions ahead of and following trap to permit removal of entire trap from line.

No Bypasses

Because of the rapid spare trap interchangeability, there is no need for bypasses to keep a unit in operation in event of trap failure. The cost of bypass installations is avoided, as is the waste that occurs when bypasses are in use, or accidentally left open. (Experience indicates that bypasses are often left open not due to trap failure, but due to reducing valve failure which allows steam pressure to exceed maximum trap operating pressure.)





Condensate Headers

Another installation technique which saves installation and maintenance cost is the use, wherever possible, of trap manifolds. Traps and manifolds can be assembled in the plant pipe shop under ideal conditions for good workmanship and minimum time consumption. After assembly the manifolds are taken to the site of installation where lines from units in the vicinity are run to the traps. Traps are thus grouped where they can be found easily and where they are readily accessible for inspection and maintenance.

\$25,000 Trap Maintenance Saving

Records kept on the Armstrong trap installation described here show that the cost of repair parts and complete replacement traps was approximately \$10,000 less annually than with the traps previously used. Reduction in maintenance labor brings the total saving to \$25,000 per year. And fuel savings attributable to the traps are at least equal to the maintenance saving.

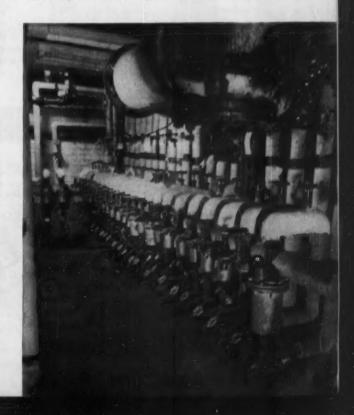
FOR COMPLETE INFORMATION, ask for the No. 1, 1956 issue of the Armstrong Trap Magazine, together with a copy of the Armstrong Steam Trap Book containing complete data on Armstrong traps plus selection, installation and maintenance recommendations. Call your local Armstrong Representative or write:



ARMSTRONG MACHINE WORKS
858 Maple Street • Three Rivers, Michigan

ABOVE: A complete unit trapping manifold hookup made in the customer's piping shop. Note unions, shut-off valves, test valves and strainers for easy maintenance.

BELOW: Insulation view of trapping hookup pictured above. All traps easily accessible for inspection and maintenance.



GET THE BEST SOLUTION TO ANY TEMPERATURE

with Foxboro



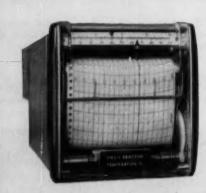
Dynalog Electronic Instruments

Complete line of indicators, recorders, and controllers employing the advanced Dynalog measuring system in which a friction-free air capacitor replaces conventionial slidewire — provides continuous, stepless balancing action. Dynalog Instruments provide up to six records on a single round chart. For use with resistance or voltage type primary elements — pneumatic or electric control action.

Multi-Record Dynalog

- 6 color-coded temperature records on one round chart.
- Each record line a distinctive, non-smudging color.
- No slidewire no batteries no standardizing.
- · Thermocouple or resistance bulb types.

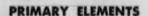




Consotrol Recording Control Station

One of the complete Consotrol line of compact panel indicators, recorders, and controllers. This advanced control station features full 4" chart and scales, six-months' ink supply, bumpless auto,-man, transfers. The M/58 Consotrol Controller, shown here integrally mounted, provides:

- All four control actions, with two reset ranges, easily adjustable to widest variations in operating conditions.
- Easy lever-setting proportional band, calibrated to 500%.
- High sensitivity and precision due to unique "floating disc"
- balancing action—even at widest settings of proportional band.
- Interchangeable "plug-in" components.
- Continuously variable reset resistance gives 500:1 rangeability.



A complete selection of primary elements for filled thermal systems, resistance bulbs, and thermocouples. Besides standard and thermocouple types, special elements and accessories are available to meet the requirements of virtually any industrial application.



Dynatherm Resistance Bulb

For use with Dynalog Electronic Instruments.

- Superior measurement performance for temperature up to 600°F.
- Fastest response due to positive metal-to-metal end contact with standard wells or sockets.
- Highest sustained accuracy. Permits use of extra-narrow scales ideal for precise temperature difference measurements.



Roll Surface Temperature

- Continuous, automatic measurement or control of roll surface temperatures up to 450°F.
- Extra-rugged construction with a "leather" touch. Won't mark or score the roll.
- Eliminates friction, radiation, and convection errors.
- Simplest, most accurate way to measure roll surface temperatures.

PROBLEM

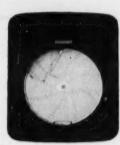
from - 450°F to + 2800°F

Instrumentation

Model 12A Temperature Pneumatic Transmitter

- Simple way to measure remote temperatures in the -100°F to +1000°F range. Operating spans of 50°, 100°, 200°, and 400°F.
- Compensated for ambient temperatures and pressures.
- Compact, easily installed. Uses regular 1/4" O.D. tubing transmission lines
 no troublesome conduits, no costly capillary tubing.
- Suitable for any hazardous, corrosive, or outdoor location.





Electric Proportional Action Controller

- Can be used with any Foxboro measuring system — mechanical or electrical.
- Precise, frictionless control action through electronic relay and electric valve operator.
- 3 types of proportional control action available.
- Setting knob permits easy, stepless adjustment of control band throughout range of instrument.

Whenever you have a temperature problem in the -450°F to +2800°F range, you can depend on Foxboro Instrumentation for the best solution. Foxboro's outstanding combination of truly advanced instruments and unequaled experience in applying them, has successfully solved temperature problems as widely different as helium liquefaction and jet engine testing. Foxboro offers a wide variety of primary elements, transmission devices, indicators, recorders, and controllers. Whether a single instrument or a combination is required - filled-system, electronic, or electric - you can be sure of fitting the process exactly. Unique Foxboro developments, such as Dynalog® Electronic Instruments, Dynatherm®® Resistance Bulbs, and the 12A Temperature Transmitter, continually maintain control standards in step with every advance of modern processing. A few of the instruments which typify Foxboro's betterengineering are shown on these pages. Chart below shows complete temperature ranges covered by Foxboro measuring systems. Write for complete details. The Foxboro Company, 369 Norfolk St., Foxboro, Mass.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

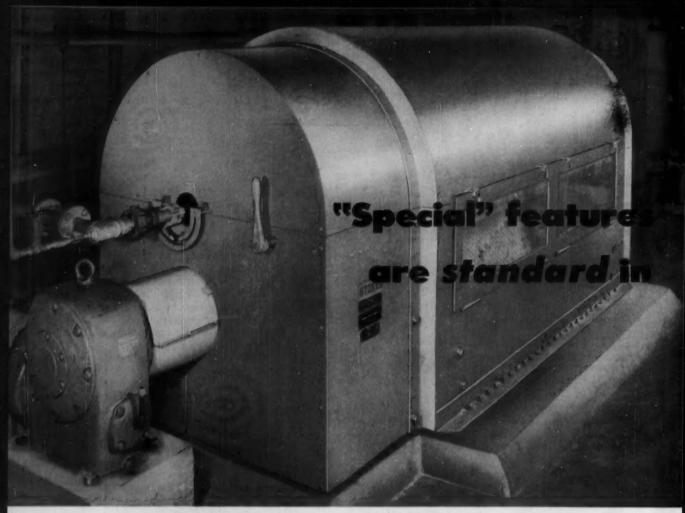


TEMPERATURE

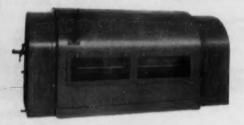
measurement and control

Locate your problem temperature in this table DEGREES FAHRENHEIT

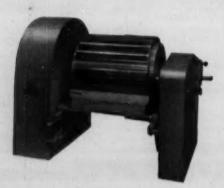
ORDER ON THE CONTROL OF THE CON



A Stokes flaker used by Tennessee Eastman Company in the production of Tenamene 3 inhibitor.



Around-the-clock operation of this Stokes flaker produces 35 tons daily of an organic resin. Total enclosing of 2½ ft. by 6 ft. unit eliminates dust and fume hazard.



600 pounds per hour of a petroleum-base wax with a melting point of 180F is flaked on this 24" by 24" Stokes machine.



Uranium slurry is processed at a rate of 250 pounds of dried material per hour... with this Stokes totally enclosed, 24" by 24", single drum dryer.

that assure economy Stokes drum dryers and flakers

STOKES drum dryers and flakers are engineered to be as modern as the new products that you'll process with them. They are precision machines, designed by specialists in chemical processing equipment. Standard features built into them, usually considered "special" in this type of equipment, make them exceptionally economical to operate . . . high in production efficiency, low in maintenance.

Count on Stokes for these design "extras"—

Rigid doctor blade arrangement.

End scrapers—provided as standard equipment.

Anti-friction roller bearings.

Lateral roll adjustment—to assure edge alignment.

Totally enclosed end frames—to protect bearings and power drive.

Six-point, edge pressured end board adjustment—to prevent plate deflection and leakage.

Amply powered, compact variable speed drive—to provide high torque.

Stable, balanced drums—to hold tolerance and shape at high or low steam pressures.

For information and specifications, write to Stokes today . . . or contact your nearest Stokes office. Call on the Stokes Advisory Service, too, for valuable help, not only in applying drum dryers and flakers, but also in correlating the operation of this equipment with other processes in your plant.

Bring your production problems to the Stokes Laboratory

For many years, Stokes has maintained a complete laboratory service for its customers. Fully equipped with both pilot and production-size equipment, this laboratory can help you to apply to your own problems the knowledge gained during more than half a century of experience. From it come recommendations for processing techniques, most effective size and type of equipment, special designs or modifications . . to assure that you realize the full potential of the Stokes equipment that you use. Call your local Stokes office for a discussion of the problems you'd like the Stokes Laboratory to investigate.

Process Equipment Division

F. J. STOKES CORPORATION

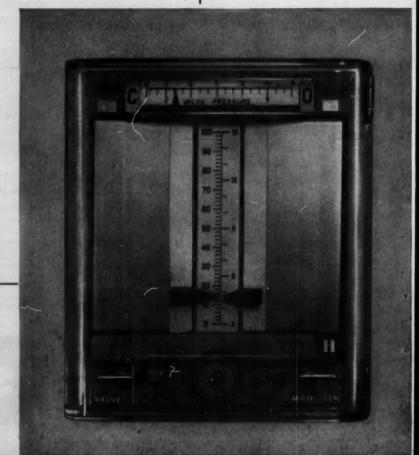
5512 Tabor Road, Philadelphia 20, Pa

STOKES



for simplest

Both the Tel-O-Set indicator and recorder have vertical indicating scales on which large, opposing pointers clearly show measured value and set point. The control knob and transfer switches are located near the bottom of the case, where they can be manipulated without the operator's hand obscuring the view of the pointer and scale.



Write for Bulletin 7202.

Design your instrumentation

installation, startup, service

-with Tel-O-Set instruments

The exclusive features designed into *Tel-O-Set* miniature instruments save you time, trouble and money . . . from the instant these instruments are installed on your control panels.

Easy installation. The indicating and recording chassis is a complete assembly that can be supplied separate from the case. Since the case contains the valve pressure gage and pressure regulator, you can install it in the panel, make complete piping connections . . . and then insert the instrument chassis later, at startup.

Foolproof startup. Because it can be shipped separately, the chassis is protected against dirt and damage until it is ready to begin service. Air lines can be checked, control valves stroked and final inspection made before the chassis and controller are installed.

Serviced in seconds. Down-time for instrument maintenance is eliminated, for a complete

chassis can be replaced in just a few seconds. There is no loss of control during replacement ... no disturbance to electrical connections. To adjust zero and span, or to inspect parts, you can partly withdraw the chassis from the case, without interrupting operation.

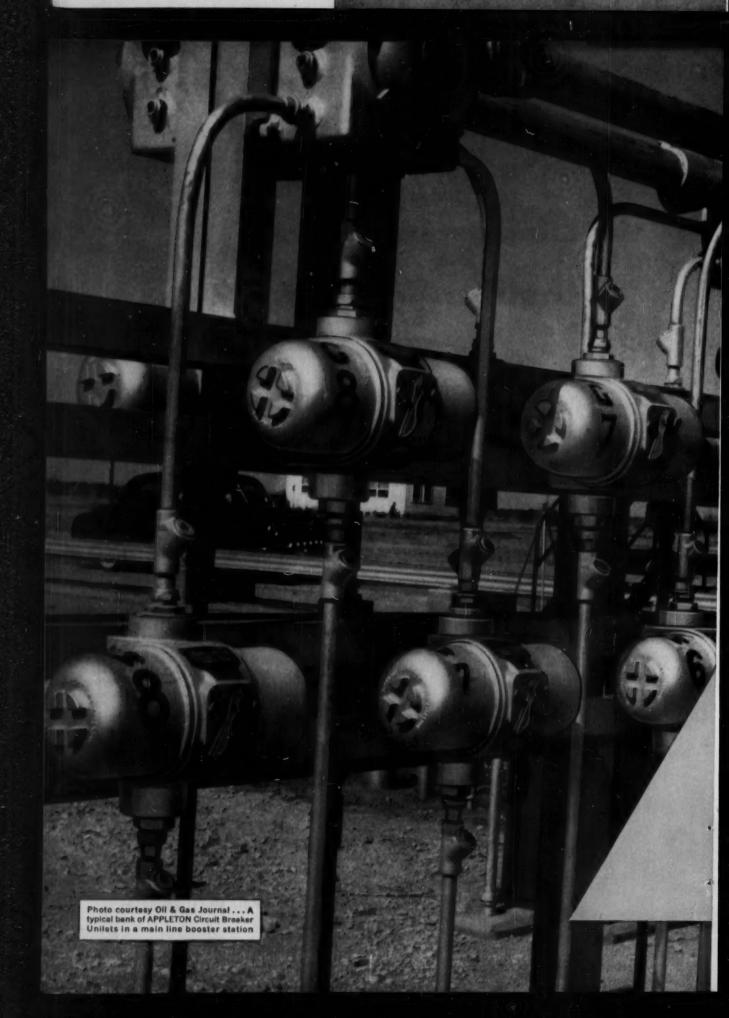
Tel-O-Set instruments can handle a broad range of temperature, pressure, flow and liquid level applications. They work with any type of pneumatic force-balance controller. They are sensitive and accurate . . . have true linear calibration . . . respond instantly to changes in measured variables. For a discussion of how you can use them profitably, call your local Honeywell sales engineer . . . he's as near as your phone.

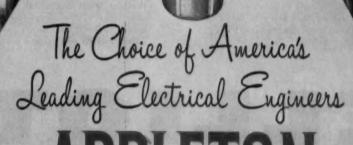
MINNEAPOLIS-HONEYWELL REGULATOR Co., Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.



Honeywell BROWN INSTRUMENTS

First in Controls





CIRCUIT BREAKER, MOTOR STARTER and COMBINATION MOTOR STARTER

APPLETON Circuit Breaker and Motor Starter Unilets your best choice for positive lasting protection against explosion, dust, and rain! Regardless of the installation, where absolute safety is required . . . APPLETON can serve you better!

7 REASONS FOR APPLETON SUPERIORITY

7 REASONS FOR APPLETON SUPERIORITY
1. Full 7-thread explosion-proof pretection.
2. Unmatched accessibility. 3. Compact,
lightweight construction. 4. Unit may be added
quickly, easily. 5. Flexible field set-ups
with single and duplex maie and female hub
adapters. 6. Combinations meet U.L.
requirements through approval of components.
7. First to be U.L. approved for banked
circuit breaker grouping.

SOLD EXCLUSIVELY THROUGH SELECTED WHOLESALERS. AN APPLETON ENGINEER WILL HELP YOU PLAN YOUR INSTALLATIONS WITHOUT OBLIGATION.

Also Manufacturers







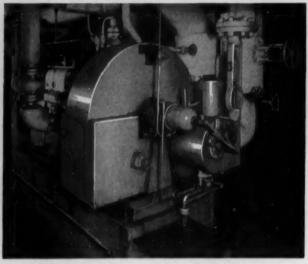


APPLETON ELECTRIC COMPANY • 1742 Wellington Avenue • Chicago 13, Illinois



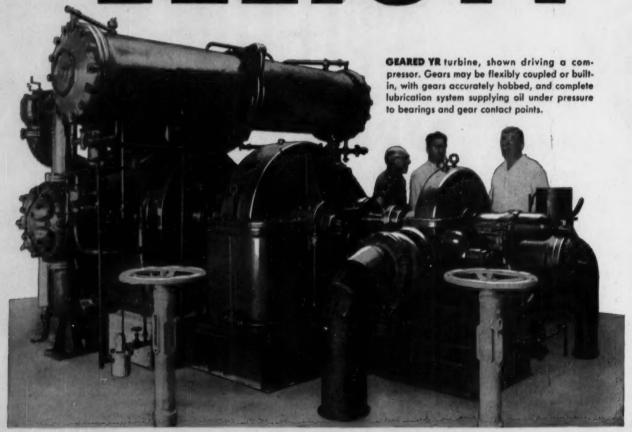


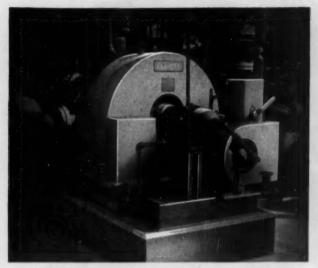
TYPE JR, shown driving a small pump. This is a simplified turbine design of rugged and reliable construction for low horsepower requirements and minimum first cost. Rated up to 45 hp, 4000 rpm. Maximum steam conditions—250 psig, 500 F. and 50 psig exhaust pressure.



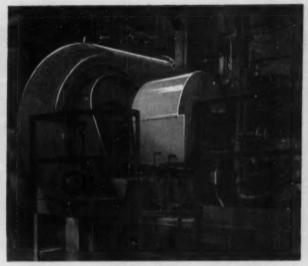
TYPE YR, here driving a boiler-feed pump. This is the standard Elliott mechanical drive turbine preferred all over industry. Five sizes — capacities up to 2000 hp, speeds to 7000 rpm. Steam conditions up to 600 psig, 750 F. and 75 psig exhaust pressure.

ELLIOTT





HIGH BACK-PRESSURE turbine, shown driving a boilerfeed pump in an oil refinery. These turbines using basic wearing parts of the standard YR, but with extra heavy casing and readily removable extra-packing glands. Good for exhaust pressures up to 250 psig.



MULTISTAGE turbine, shown driving a compressor, Photo shows single-valve turbine, but multi-valve designs can be furnished. Speeds up to 11,000 rpm, steam conditions up to 850 psig, 850 F. Condensing and noncondensing ratings 400 hp and up. Custom-built to your requirements.

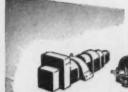
...the name you can depend on for all Mechanical Drive Turbine needs

WHATEVER YOUR REQUIREMENTS, the Elliott line of turbines can provide the simple, reliable answer. From the smallest type JR up to the largest multistage, Elliott mechanical drive turbines have the design, the construction and the flexibility to do the job right. Contact your local Elliott field engineer or write Elliott Company,

Jeannette, Pa. for information and descriptive bulletins.



























GENERATORS DEACRATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS



WORLD'S MOST COMPREHENSIVE LINE OF TEMPERATURE INSTRUMENTS

Here's a time-saving, money-saving tip. Whenever you have a temperature problem . . . whether it involves simple, but accurate indications or intricate, sensitive control . . . call on WESTON. From WESTON'S comprehensive instrument line you can readily select . . . you are sure to get . . . the temperature instrument exactly suited to your requirement.

For simple indications . . . Weston provides the famous all-metal thermometers — or the filled system types for remote readings — or electrical resistance and thermocouple types.

For recording . . . select from a complete line of filled system recording thermometers — single or multi-point electronic recorders — or, where instrument flexibility is desirable, compact, portable recorders are available.

For control . . . there's a complete line of mechanical instruments — null-balance type instruments — as well as self operating controllers.

So remember . . . whenever you have a problem involving temperature measurement or control, the quickest, the surest solution requires no more than a phone call to your nearest WESTON representative. Literature on request. Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey. A subsidiary of Daystrom, Incorporated.



WESTON



All-Motel
THERMOMETERS — industrial and
leboratory types

TO INDICATE

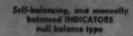


Flectrical Resistance
THERMOMETERS

also thermocouple types



Filled system
THERMOMETERS
For remote receilings





Pyro-Millivoltmeters panel or pertable form



Parting a fair

Single and Multi-point RECORDERS null balance type

TO RECORD



Miniature Parrable RECORDERS filled system type



Miniature bi-metal



Mechanical RECORDERS



Recording CONTROLLERS
null belance type

CONTROLLERS



Mochanical CONTROLLERS



Indicating CONTROLLERS
null bulance type



Sonsitivo contact-making RELAYS

TO CONTROL

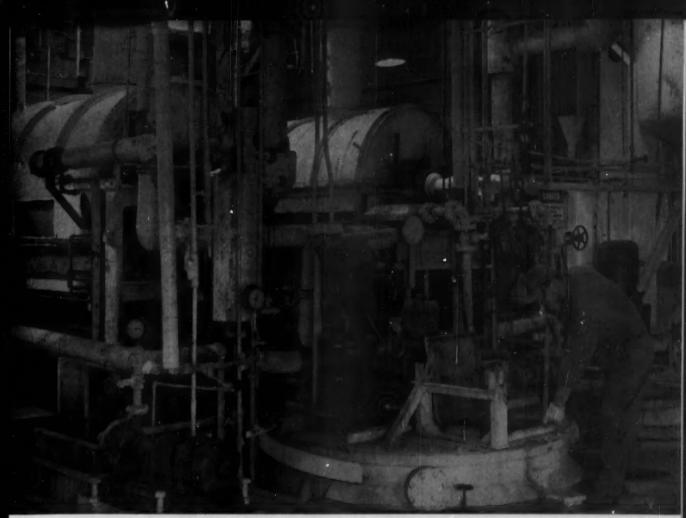


PRE-HEATED SULFUR is combined with pre-heated hydrogen in Stainless Steel catalyst chamber to form hydrogen sulfide gas.

HOW STAINLESS STEEL

SODIUM SULFHYDRATE comes through Stainless tubing into this Stainless filter press and is pumped into Stainless weigh tanks.





AFTER FILTRATION, the solution is pumped to these flaker feed tanks, equipped with Stainless pumps, agitators and piping.

UPHOLDS PURITY in sodium sulfide production

AT HOOKER ELECTROCHEMICAL COMPANY, NIAGARA FALLS, N.Y.

Hooker Electrochemical Company, Niagara Falls, N.Y., is a major factor in the marketing of sodium sulfide in the United States; and the firm goes to extraordinary lengths to protect its market by maintaining the highest standards of purity.

Almost automatically, this means the generous use of Stainless Steel where there is the slightest danger of contamination, resulting from corrosion. Stainless Steel serves in the sulfur boiler, pipelines, condensers, separators, filter presses, pumps, flakers and agitators. Besides guarding purity, Stainless Steel often simplifies design. The agitators, for instance, could be made much larger, because the strength of Stainless permits it to operate at such a high stress level. Hooker had no trouble fabricating their Stainless equipment; in fact, it was practically all done locally.

To guard purity, resist corrosion, withstand high stresses and temperatures, nothing can equal Stainless Steel for chemical equipment. To be sure of service-tested quality, specify USS Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH - AMERICAN STEEL & WIRE DIVISION, CLEVELAND - COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH - TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. - UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS

UNITED STATES, STEEL COMPANY, NEW YORK

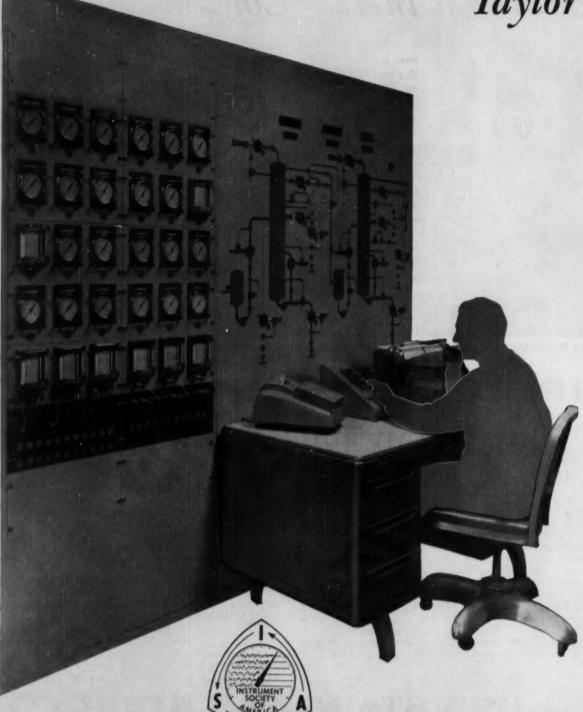
USS STAINLESS STEEL

SHEETS . STRIP . PLATES . BARS . BILLETS . PIPE . TUBES . WIRE . SPECIAL SECTIONS



BIGGEST NEWS

Taylor



AT THE I.S.A. SHOW

Trans-Scan-Log Control System!

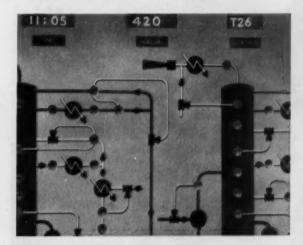
MAKE the Taylor booths your headquarters for scanning and logging at this year's ISA Show. You will see an actual working model of the TSL System... the soundest and the most logical integration of process control with process scanning and logging yet devised... a boon to advanced systems engineering.

The Taylor system goes far beyond today's practices. It is, in essence, a very compact intelligence center which coordinates all related process data, enabling the operator to instantly visualize, evaluate and act upon every processing irregularity as it occurs—without leaving his desk in front of the panel. In addition, it employs the most modern techniques in scanning and logging. Thus the project engineer can observe the entire plant operation more efficiently than ever before.

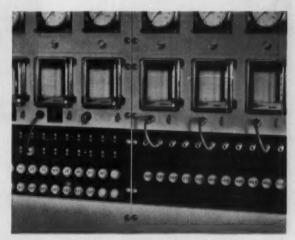
As well as furthering automation in plant operation, the TSL System is a research tool in collecting data on existing units. It can provide accounting or marketing departments with production data as it is accumulated, either on punch cards or tape.

The complete system takes approximately 60% of the space normally required by a standard graphic panel without scanning and logging. Because of this compactness one operator can identify and correct any off-normal condition, as well as having a continuous trend record. It is highly dependable, because the Taylor system makes it possible to use simpler, less expensive units.

Nearly two hundred process engineers from all over the country have already visited Rochester to see this advanced equipment demonstrated. If you are unable to visit the ISA Show your Taylor Field Engineer will be glad to make the necessary arrangements for you to see the TLS system in operation. Meanwhile, write for **Bulletin 98268**. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.



Graphic Panel—A normal 20-foot graphic panel can easily be compressed into a 5-foot section because space is not required for receivers. Flow lines and symbols can be modified quite simply for process changes. Station identifications are illuminated, also digital readout of time, value and station for ondemand or off-normal. (Off-normal alarm also audible). Point scanning is continuous at the rate of one per second. Scheduled point logging can be set as required.



Process Control Panel—Note plug-in TRANSET* pneumatic control stations, complete with automatic to manual switching. Recorders and indicators are easily interchangeable. All internal connections are completed, ready for field hook-up. Station identification lights give visual tie-in with graphic panel. Convenient electrical and pneumatic plug jacks are provided to record trends of any non-controlled variables.

*Rog. U. S. Pat. Off.

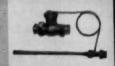
Taylor Instruments MEAN ACCURACY FIRST

FULTON SYLPHON

TEMPERATURE REGULATOR

If A Temperature Regulator Will Do It, Fulton Sylphon Has It





No. 1100 PULTROL THERMO-STATIC PILOT CONTROLLER —for pneumalic or hydroxile camed systems. Nos TEMPERATURE REGULA. TORS—control of liquid temperature is food processes, etc.





No. 999-7 TEMPERATURE

No. 999 TEMPSRATURE RES-ULATOIL—for liquide, air ar goose in Industrial precesses, etc.





He. 923-G TEMPERATURE REGULATOR -- quick adjusting type for process central, sec.

No. 726 TEMPERATURE REG. ULATOR—sufery type for ongines, process control, etc.





No. 992-D BELLOWS COS-TROL VALVE—for use with Fultral Pilot Controller, etc. No. 192 PRESSURE RED-





Nos. 1290 & 1281 TEMPER-ATURE REGULATORS—For Engines, graces water, etc. No. 1626 PLOAT VALVE for liquid level control. Process unit, pilot plant, laboratory, or washroom—Fulton Sylphon has the right solution to your temperature regulator problems—a solution that gives you two exclusive advantages at no extra cost.

UNMATCHED SERVICE—Fulton Sylphon service

UNMATCHED SERVICE—Fulton Sylphon service can save you headaches and money. It's the kind of competent, responsible engineering advice and follow-through that only more than 50 years' experience can make possible. What's more, a nationwide network of Fulton Sylphon offices makes this engineering service available practically in your backyard.

available practically in your backyard.

THE RIGHT REGULATOR—The widest line of temperature regulators anywhere assures you of the right control at lowest cost. No matter which regulator is best for you, you can be sure of the same dependable performance. Fulton Sylphon itself makes all components, and is acknowledged to be the leader in bellows—the heart of every Sylphon regulator.

HEADQUARTERS, U.S. A.



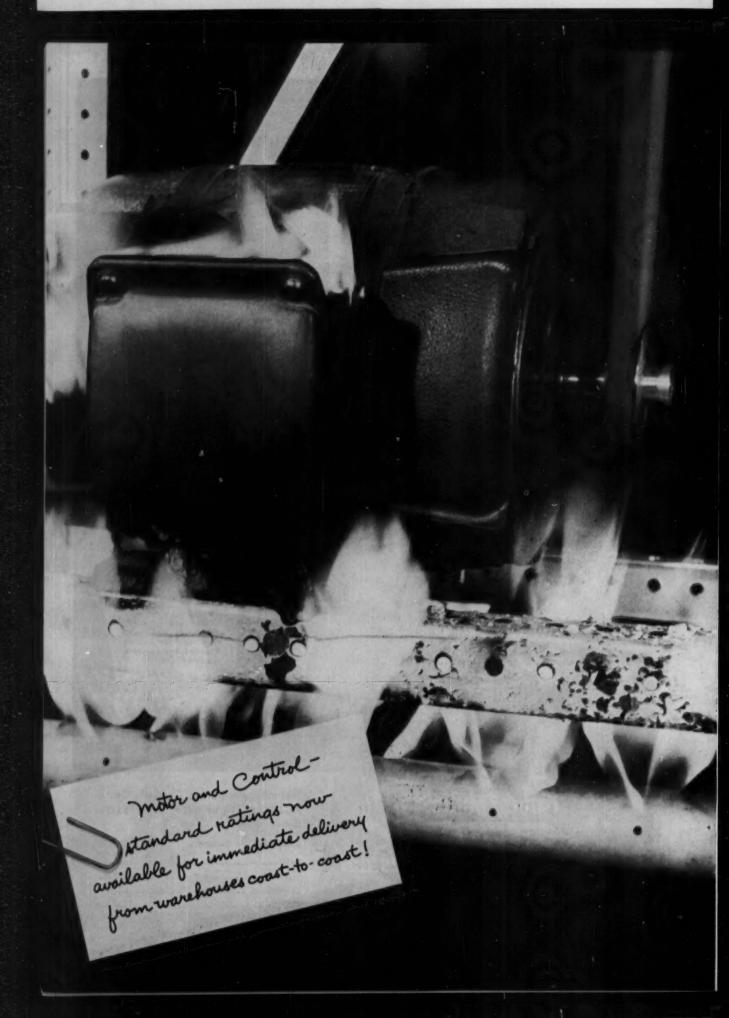


FULTON SYLPHON DIVISION

Knoxville 1, Tenn.

Robertshaw-Fulton Controls Co. FULTON SYLPHON DIVISION Knoxville 1, Tenn.

Please send me Catalog RC-D



TOMORROW:

A standard motor that can survive infinite heat

The new <u>life-line</u> A is another step closer

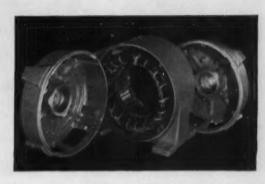
Westinghouse is working on tomorrow's motor today. Investigating new materials—testing existing motor designs.

No standard motor today can survive the ultimate test shown here. But we do know that the new Life-Line® "A" can operate under higher temperatures than ever before. It has stronger insulation and better bearing protection than any other motor on the market. It's industry's closest approach to a standard motor that is absolutely heatproof.

Your Westinghouse sales engineer can show you many additional reasons why the Life-Line "A" is industry's most advanced and preferred motor. Call him today.

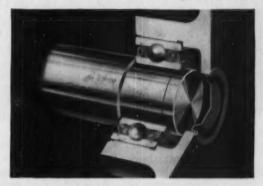
21926-A

WATCH
WESTINGHOUSE!

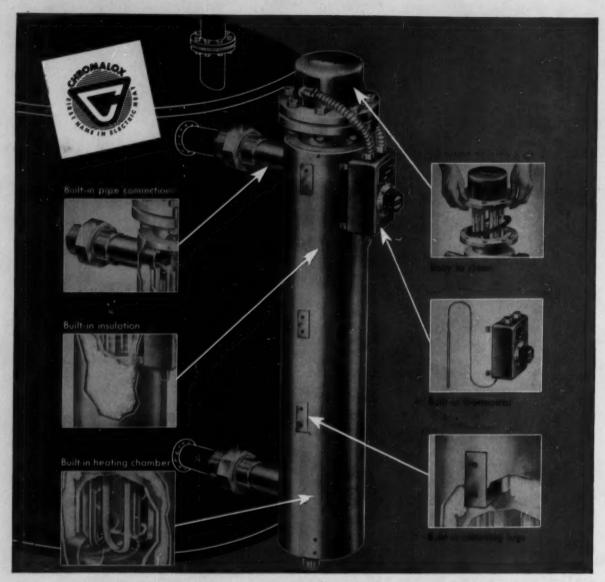


New fortified insulation includes exclusive Bondar, Bondite and Mylar*—three good reasons why the Life-Line"A" is so resistant to heat or any other motor contamination.

*DuPont Registered Trade-Mark



Two outer seals of new 4-way sealed bearing act as flingers and literally throw off damaging contaminations. Inner seals, attached to outer bearing race, are stationary and form a positive labyrinth.



Compact, packaged Electric heating for Liquids and Gases!

Chromalox Electric Circulation Heaters are completely packaged heat exchangers designed for a wide variety of liquid and air heating jobs. In them, you get a complete, compact heating package ready for quick, economical installation. All you do is make the necessary pipe and electrical connections.

What's more, you get all the advantages of electric heat—including accurately maintained heat at the temperatures you select, instant heat-up, without elaborate facilities . . . and high efficiency because you generate heat right at the job.

Compared with fuel-fired systems, the

low original cost and operating expense of Chromalox Electric Circulation Heaters helps you realize real dollar savings. There's no expensive firing and upkeep cost.

Whether you are heating water, oils, steam, air or heat transfer media, call your Chromalox representative—he's the man with the electrical answer to your heating problem.

For the full story on Chromalox Electric Circulation Heaters, write for a copy of Bulletin 701.

Edwin L. Wiegand Company

7514 Thomas Boulevard, Pittsburgh 8, Pa.

NOW

ammonium nitrate-via the Stengel Process

The new type ammonium nitrate is produced in a compact C & 1-designed and built plant using a cooling chamber approximately one-fifth the size of conventional prilling towers. Capital investment is about 25% less than that required for old type prilling plants of comparable capacity. The modified Stengel Process does not require dryers, yet produces a superior prill of uniform size with about .02% moisture content. The high density of the product allows it to be stored in a minimum space without the danger of caking and assures easy application.



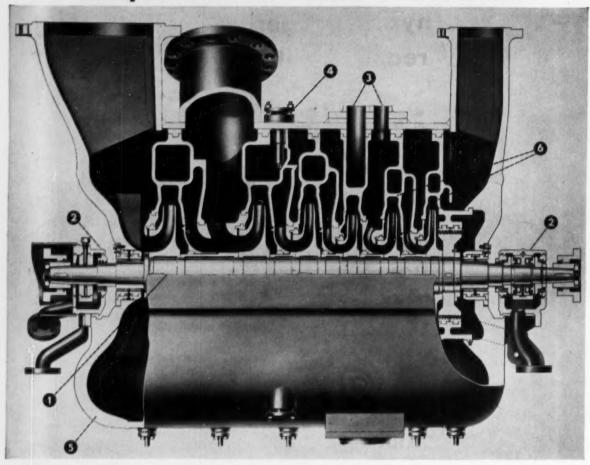
THE CHEMICAL AND INDUSTRIAL CORP.

CINCINNATI 26, OHIO

Designers and Builders of Plants for the Processing of Ammonia— Available Throughout the World

NITRIC ACID . PHOSPHORIC ACID . AMMONIUM NITRATE
COMPLEX FERTILIZER . AMMONIUM PHOSPHATE

Worthington announces new centrifugal compressor with 6 stand-out features



Worthington's GUR multi-stage compressor is the result of intensive surveys conducted among the nation's leading industrial engineering, maintenance and operating personnel. Their recommendations, plus Worthington's famous high quality standards of manufacture and design, have combined to produce this advanced compressor!

The GUR-characterized by maximum accessibility plus ease of installation and maintenance-offers you:

- 1. Casings and diffusers horizontally split at centerline with no bolting of the diffusers to the casing. This design guarantees maintaining pre-established internal clearances during reassembly. It also simplifies your installation problem and permits much greater ease of maintenance and inspection.
- 2. External Bearings. Mounted completely external to the casing and open to atmospheric pressure. Bearing maintenance and inspection is simplified. Bearing oil is prevented from contaminating the gas being compressed.
- 3. Accommodations for large bleedin bleed-out flows permits handling of different levels of refrigeration or stepwise compression of process loads and knockouts with one compressor casing.
- 4. Liquid injection cooling reduces heat of compression. It eliminates need to dismantle compressor to clean water passages and maintenance associated with exchanger bundles.
- 5. Castweld fabricated design insures known sound components from basic materials to finished product. Customer benefits because we can control tolerance between calculated designed compressor weights and actual finished weights. Castings are small and in-

spected before assembly. There's less scrap risk-shipping dates are realistic.

6. Horizontally split enclosed diffusers allow continuous gas guidance through compression range. Compressor casing is not used as part of diffuser. Should corrosion or erosion occur, only a particular defaced diffuser need be replaced—not entire casing.

The Worthington Multi-Stage compressor is designed for use with air, ammonia and most hydro-carbon gases. Five casing sizes give a capacity range from 570 to 82,000 C. F.M. per casing with discharge pressure to 950 psig. For details, contact your Worthington District Office...or write Section A-6121, Worthington Corporation, Harrison, N.J.

WORTHINGTON



FROM EPOXIDATION TO POLYMERIZATION ...

ALBONE® hydrogen peroxide puts a wide range of reactions at your finger tips

Hydrogen peroxide, when properly activated, is an effective oxidizing agent for organic synthesis. For example, when peroxide is activated to form a peracid, reactions are often faster and yields are higher. Other methods for activating hydrogen peroxide to bring about specific reactions are continually being considered by Du Pont.

Here are a few of the possible uses for Du Pont hydrogen peroxide:

- . EPOXIDATION
- HYDROXYLATION
- QUINONE FORMATION
- ESTERS FROM KETONES
- LACTONES FROM KETONES
- KETONE CLEAVAGE
- SULFUR OXIDATION
 - NITROGEN OXIDATION
 - POLYNUCLEAR CLEAVAGE
 - PHENOL PREPARATION
 - POLYMERIZATION

Du Pont's long experience in the manufacture and use of "Albone" hydrogen peroxide is at your disposal. If you use hydrogen peroxide now-or if you're planning a product or process in which this versatile chemical can play a part-feel free to consult us,

HYDROGEN PEROXIDE

Prompt Delivery in Drums and Tank Cars

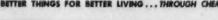


BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

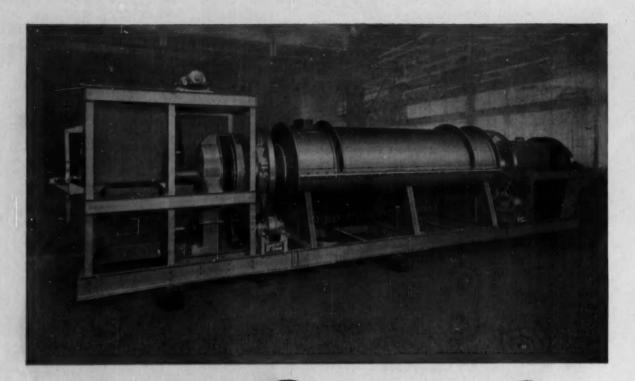
Du Pont will be glad to help you improve your products and processes involving hydrogen peroxide. For prompt advice on your specific application or idea, just write to:

ALBONE

E. I. du Pont de Nemours & Company (Inc.), Electrochemicals Department, Peroxygen Products Div. CE-9, Wilmington 98, Delaware.







continuous Calciner and Cooler



Two Bartlett-Snow Rotary Oil-Fired Batch Kilns Pre-heating Charges for Electric Furnaces.



Two Oil-Fired Continuous Kilns Working Temperature 2300° F.

... permits materials to be processed continuously at temperatures from 900° F to 2100° F in a reducing, oxidizing or neutral atmosphere, cooled, and discharged at 200° F or lower.

• The chrome nickel alloy tube can be lined if desired, to permit processing without bringing the material into contact with metal at elevated temperatures. Feed hopper, variable feeder, seals and breechings are all supported on a single frame to assure proper alignment and efficient trouble-free operation. Our complete laboratory facilities enables us to determine accurately the time cycle, temperature, special atmosphere and other conditions needed to produce a given result, before the production unit is designed or built. Let us work with you on your next job!

DESIGNERS

- WOINEERS

BARTLETT SNOW

FABRICATORS

ERECTORS

DRYERS . COOLERS . CALCINERS . KILNS — Complete Facilities Including Materials Handling



\$10,000-a-year saving with just \$450 of Uscolite Pipe"

Rarely can you find a more corrosive environment than that of a tannery. For instance, pipes in one large Minnesota tannery (carrying salt, sulfuric acid, alkali, hard water and chrome liquor) became corroded and had to be replaced frequently, some as often as every week. Also, there was the constant hazard of dangerous chemical leaks. A piping break always damaged the floor, often stopped plant operations.

Then, 2 years ago, they ordered \$450 worth of Uscolite® Pipe. Result: savings of \$10,000 in just one year.

"In all that time," says the tannery manager, "the Uscolite Pipe has shown no sign of wear, even though in use 24 hours a day, 6 days a week. We're ordering more and more of it for use throughout the plant."

Uscolite plastic pipe is extremely light in weight, yet has very high impact strength. It is resistant to corrosive chemicals and is non-contaminating. The Uscolite line includes everything for a complete pipe assembly, including the Hills-McCanna Valve. Contact any of the 28 "U. S." District Sales Offices, any of the selected "U. S." Distributors, or write us at Rockefeller Center, New York 20, New York.



After 2 years on the job, note the smooth, unharmed exterior of Uscolite Pipe (at left) while metal pipes are heavily corroded.



Mechanical Goods Division

United States Rubber

new source of high quality lime ...quicklime and hydrate

West End, supplier of quality chemicals for over 31 years, proudly announces expansion limerock resulted in the construction of a large new processing plant. The photo shown supply. Inquiries and your specifications are invited. quantities of highest quality lime to serve the needs of growing western industry. of its hydrate and quicklime production. Discovery of an extensive deposit of high grade We suggest you give consideration to West End as a primary source of here is of the giant 340 foot rotary kiln. The plant will soon be producing increased

SODA ASH . BORAX . SODIUM SULFATE . SALT CAKE . HYDRATED LIME EXECUTIVE OFFICES, 1956 WEBSTER, OAKLAND 12, CALIFORNIA · PLANT, WESTEND, CALIFORNIA **End Chemical Company** WESTENDY West

Rugged insulation finish for indoor and outdoor lines, tanks, and vessels

Reduce insulation costs by providing both finish and color identification at the same time with a protective coating of Armstrong Insulcolor. Insulcolor comes in seven colors, plus a clean white. It is applied by brush or spray to all types of insulated lines, tanks, and vessels, indoors or outdoors. There are no solvents in Insulcolor that create a hazard during application. Dried film is fire-resistant, and lasts for years under severe weather conditions. Maintenance is easy, as dirt washes readily from Insulcolor's smooth surface.

Insulcolor is one of the quality products in the complete line of Armstrong Industrial Insulations. Armstrong also offers you a complete contracting service, geared to install these products economically and efficiently.

For full details on Insulcolor or any other Armstrong materials that may help solve your insulation problems, send for free booklets. Check the ones you want on the coupon below.







☐ Armstrong Insulcolor® Weatherproof Coating in Seven Colors



☐ Armstrong LT Cark Cov-ering, a New Type Cold Line Insulation



Armaglas Insulations for Pipes, Tanks, and Vessels



Armstrong Armaflex*, a New Flexible insulation for Piping

TRADE-MARK

Armstrong Cork Company 2509 Shorpe St. Lancaster, Pa.

Please send me the free booklets checked.

Please have an Armstrong representative call.

Position

Address

City State



Designed for use in chemical plants WAGNER EP MOTORS

Here are stock motors specifically designed for the chemical industry —they're fully protected against corrosive fumes and liquids, dust, dirt or moisture.

Such protection is assured by totally-enclosed fan-cooled construction in corrosion-resistant cast iron frames. Extra protection is given the laminations by a wall of cast iron that completely surrounds the stator. Even though the

windings are completely enclosed, they are treated with a special coat of varnish that resists acids and alkalies. A running shaft seal, sealed leads and a gasketed conduit box give still further protection to these motors.

A skilled Wagner engineer, expert in motor applications, can help you select the Wagner Motor that meets your most exacting specifications. Call the nearest of our 32 branch offices, or write us. Wagner Chemical Plant Motors are available in ratings from 1 to 250 hp in standard (Type EP) and explosion-proof (Type JP) designs, and in Non-ventilated corrosion-resistant standard and explosion-proof types in ratings from ½ through 1½ hp.



Washer Electric Corporation

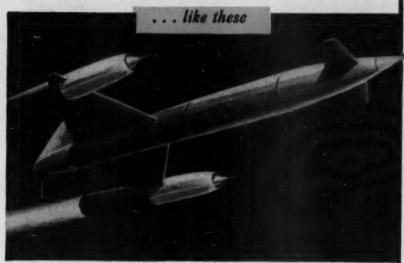
BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES



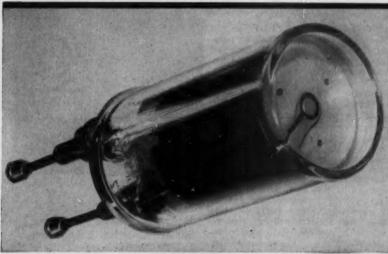
ELECTRIC MOTORS . TRANSFORMERS . INDUSTRIAL BRAKES . AUTOMOTIVE BRAKE SYSTEMS-AIR AND HYDRAULIC

Looking for something special in materials?

Norton high-purity, high-stability materials aid in solving many industrial problems



In Supersonic Flight. Marquardt Aircraft Company of Van Nuys, Cal., uses Norton ROKIDE* protective coating in its new, highly advanced ramjet engines for supersonic missiles. The flame-sprayed aoKide aluminum oxide coating greatly increases the tailpipe's resistance to excessive heat and erosion. Other ROKIDE coatings for high temperature applications include "ZS" zirconium silicate and "Z" stabilized zirconia.



In Concentrated Light. After inventing their outstanding new RF induction lamp, Sylvania Electric Products Inc. turned to Norton Company as a dependable source of high-melting, stable materials. Norton tantalum carbide was selected as the lightemitting source. Heated to a much higher temperature than tungsten filaments can stand, this material becomes the most uniform concentrated light source ever developed.

If lack of suitable materials is delaying development or improvement of your products, remember this:

Norton high-melting, fusionstabilized materials have helped solve many such problems for manufacturers, in applications ranging from home appliances to guided missiles and atomic energy equipment.

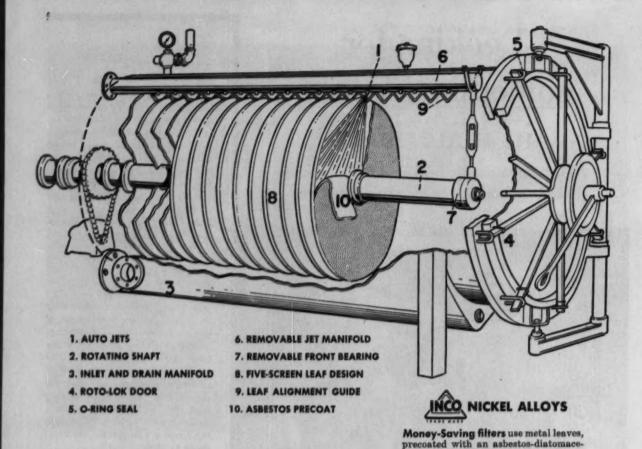
Here is a partial list of Norton refractory materials: ALUNDUM* fused alumina, CRYSTOLON* silicon carbide, MAGNORITE* fused magnesia, NOR-BIDE* boron carbide, fused stabilized zirconia, special fused oxides, refractory carbides and borides.

Another point to remember: these materials offer you combinations of thermal, electrical and physical characteristics not available in the usual refractory substances. Melting points range up to 6400°F. Electrical resistance and thermal conductivity run from low to very high. NORBIDE boron carbide, with a Knoop hardness of 2800, is the hardest commercial material made by man.

Norton high-melting materials are the basic ingredient of the famous Norton Refractory B's — refractories engineered and prescribed for the widest range of industrial uses. Norton Company supplies them in crude, processed or fabricated form, and will work with you in engineering them to your requirements. For further information, write to Norton Company, Refractories Division, 508 New Bond Street, Worcester 6, Mass.



NORTON PRODUCTS: Abrasives • Grinding Wheels Grinding Machines • Refractories BEHR-MANNING PRODUCTS: Cooted Abrasives Sharpening Stones • Behr-cart Tapes *Trade-Marks Reg. U.S. Pat.Off. and Foreign Countries



Filters "thick juice" through Monel leaves ... saves \$100 per day

In a 190-day beet sugar campaign at its Santa Ana, California plant, Holly Sugar Corporation saved \$19,000 last year in filtering sugar "thick juice".

They did it by switching from plateand-frame filter presses to wholly enclosed, "self-sluicing" leaf filters built by United States Filter Company, El Monte, California.

Monel* nickel-copper alloy internals do the work

In each filter there are 22 Monel alloy leaves, each made of five wire screens stretched between a cast hub and a specially formed U-channel rim. A pre-coat is laid on automatically in 10-minutes. After the run, it is jetted off with the cake in 4 minutes.

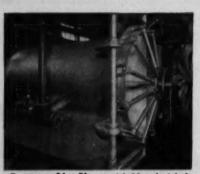
Internal parts are not only exposed to corrosion by the hot juice, but also must be designed to permit use of acid to remove scale without harm. Of course, the juice must be protected from any possible contamination by metallic corrosion products. And the screens must not deform under pressure.

Monel nickel-copper alloy provides the needed combination of high corrosion resistance and strength.

Many other sugar and salt producers find Monel alloy essential in equipment to produce high purity product at low cost. If you would like to investigate potential uses in your process, Inco's Corrosion Engineering Section will be glad to help with available data and information.

Registured Trademark

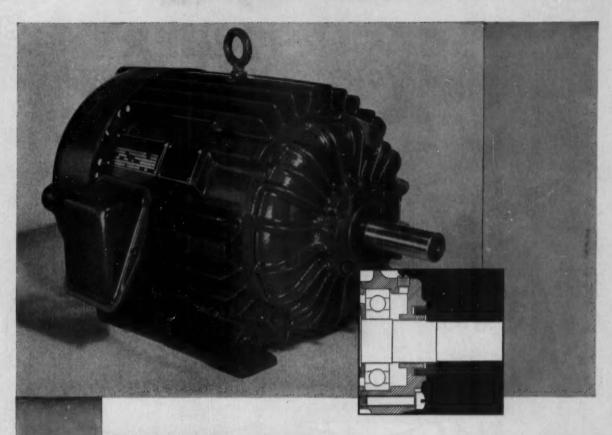
The International Nickel Company, Inc. 67 Wall Street New York 5, N. Y.



ous earth slurry, to clarify sugar juice.

Battery of jet filters with Monel nickelcopper alloy internals provides continuous flow of filtrate in what amounts to almost a "push-button" operation. Direct savings, \$19,000. Other benefits include: (1) higher quality, more uniform filtrate; (2) % reduction in square feet of filter area required; (3) faster filtering; (4) the ability to handle higher-density juice.

Monel...for minimum maintenance



Securely sealed for low maintenance -

TOTALLY ENCLOSED FAN COOLED MOTORS

When motor maintenance goes down, production goes up. Century TEFC Motor protects itself from dust, grit, chemical fumes, moisture. Shaft openings at each end are labyrinth-sealed, and there is a precision clearance between metal seal and bearing bracket.

Outside, a hose or whisk broom quickly cleans it. External fan forces jets of cooling air across the frame. Inside, vital motor parts are completely sealed off from injurious atmosphere. Factory lubrication of bearings is adequate for several years' service under normal conditions; however, whenever required bearings may be relubricated through grease plugs.

For full facts on your specific application, call the Century District Office or Authorized Distributor nearest you.

CENTURY... building TEFC Motors for 25 years

CE-66

Performance Rated MOTORS 1/20 to 400 H.P.



CENTURY ELECTRIC COMPANY

1806 Pino Street . St. Louis 3, Missouri . Offices and Block Palms in Frincipal Cities

EAGLE-PICHER BLANKET INSULATION



Since 1843



The Eagle-Picher Company . General Offices: Cincinnati 1, Ohio

PRODUCING A COMPLETE LINE OF INDUSTRIAL INSULATIONS

(Conforms to Commercial Standard CS 117 and Pederal Specification HH-1-868)

(Member of Industrial Mineral Piber Institute)



There's too much at stake – clean it right

Chemical cleaning involves costly equipment and often work stoppages. It's a job for experts. Let Dowell protect that equipment and keep production losses to a minimum when you have scale or sludge problems.

In over 15 years our trained engineers have serviced virtually every kind of equipment in plants, mills and refineries throughout industry.

In fact, Dowell has cleaned over 10,000 boilers alone!

This experience means lower costs to you—in more thorough work, restored efficiency and less production loss.

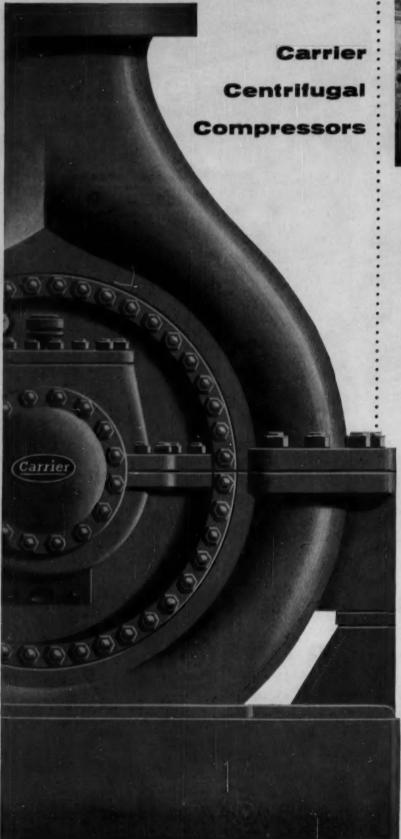
Furthermore, Dowell engineers know you value the safety of your men and equipment. Dowell uses only the latest safety equipment and techniques to eliminate hazards and accidents. Our engineers work closely with your safety personnel to establish the safest possible working procedures.

Call the nearest of more than 165 Dowell offices. An experienced engineer will be glad to talk over and help you with your cleaning problems any time—at no obligation. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept I-33

chemical cleaning service for industry



A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY





on the job at Frontier Chemical Company

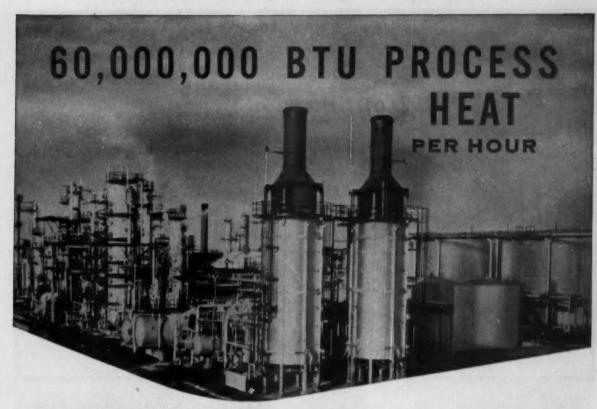
This is one of the Carrier Centrifugal Compressors serving the Frontier Chemical Company in two of its plants—in Wichita, Kansas, and Denver City, Texas. The machine for the Wichita plant was installed in 1953, the one for Denver City in 1955. Both centrifugals liquefy chlorine gas. Frontier Chemical Company manufactures caustic soda in liquid, solid and flake form, muriatic acid and related products.

Carrier makes a complete line of centrifugal and axial flow compressors for gas compression and refrigeration—up to 10,000 hp in a single unit. Hundreds of these dependable Carrier machines are on the job at dozens of chemical plants across the country—such as the Olin Mathieson Chemical Corporation, Wyandotte Chemicals Corporation, Reichhold Chemicals Company. May we assist you?

If you'd like a copy of our booklet, "Centrifugal Compressors for Industry," please telephone your nearest Carrier office. Or write Carrier Corporation, Syracuse, New York.



contrifugal compressors refrigerating equipment



A typical Struthers Wells circulating Heating System serving a major Canadian oil refinery

The Dowtherm heaters shown above are installed in the plant of a major Canadian oil refiner. The heaters are part of Struthers Wells circulating heating systems, utilizing liquid Dowtherm as the heating medium, at temperatures of approximately 700°F.

This equipment is used to supply process heat for reboilers and other heat transfer equipment, as installed in a modern lubricating oil refining operation. This type of equipment insures close temperature control and high heat transfer rates in the users. The capacity of these systems is 60,000,000 BTU per hour, making it one of the largest installations of this type.

Struthers Wells is a major supplier of circulating heating systems for both liquid and vapor service, and utilizing commercial heat transfer fluids in a wide temperature range. Hundreds of successful installations, many of them repeat orders, provide a wide background on which to base recommendations for any type of service.

Fired heaters for the direct heating of process fluids, as gas, steam, and hydrocarbons, to the highest commercial temperature ranges are also built by Struthers Wells.

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION

Crystolliasts . Direct Fired Heaters .

Evaporators . . Heat Exchangers . . Mixing and Blending Units . . Guick Opening Doors . . Special Carbon and Alloy Processing Vassals . . Synthesis Convertors .

BOILER DIVISION

BOILERS for Power and Heat , , , High and Low Pressure . . . Water Tube . . . Fire Tube . . .

PORGE DIVISION

Crunkshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Reits

MACHINERY DIVISION

MACHINERY for Sheet and Structural Metal Forming . Tengent Benders . Folding Machines . Roller Table and Tumble Die Bending Machines . Prace Brakes . Pundh

STRUTHERS WELLS Corporation

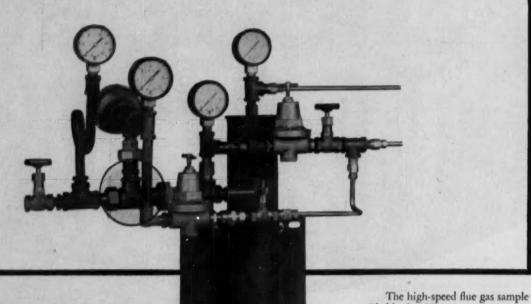
WARREN, PA.

Struthers Wells

Piants et Warren, Pa. and Titusville, Pa.

Offices in Principal Cities

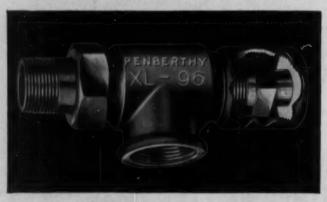
TO STOP DOLLARS from GOING UP THE FLUE



LEEDS AND NORTHRUP ENGINEERED A RELIABLE O2 SYSTEM

PENBERTHY

PROVIDED A POWERFUL PUMP in a small package



In moving stack gas to the analyzer... the Penberthy Ejector offers practical advantages over mechanical pumps. Smaller, more compact and less costly, it is assembled as an integral part of L & N's equipment. It is not subject to mechanical failure (no moving parts) and has high corrosion resistance.

provided by L & N's new steam-operated

to assure correct combustion conditions in

sampling system is instrumental in providing a concise and reliable O2 picture

an increasing number of industrial applications. Among these are - boilers, atmosphere generators, glass and open hearth furnaces, cement and lime kilns, hydroformers, SO₂ burners, cat crackers, and fluid coke units.

LOCAL JOBBER SUPPLIED INITIAL UNITS

Like L & N, you, too, will find that leading supply companies carry a complete line of standard Penberthy Ejectors suitable for most pumping applications. For special jobs or detailed technical information, write direct.

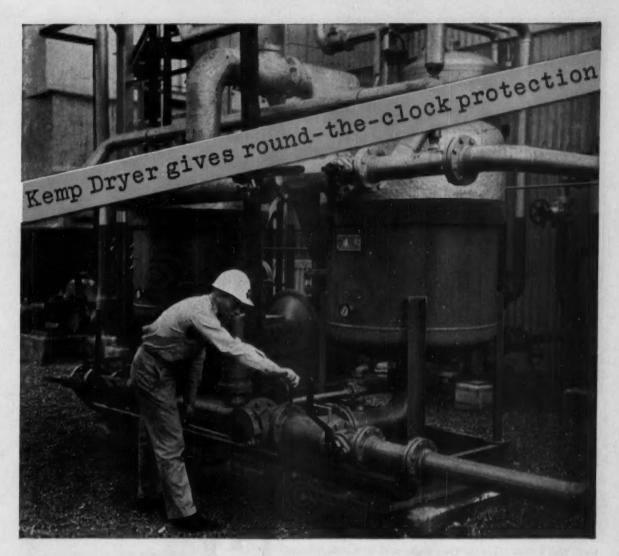
ENBERTHY MANUFACTURING CO.

Division of Buffalo-Eclipse Corporation 1242 Holden Avenue Detroit 2, Michigan

There's Certain Satisfaction in PRODUCTS



- **EJECTORS**
- EDUCTORS
- EXHAUSTERS
- SYPHONS
- ELECTRIC SUMP
- CYCLING JET



Grace Chemical Company Reports: Kemp Dryer safeguards instruments throughout plant 24 hours per day

The Grace Chemical Co. manufactures Anhydrous Ammonia and Urea 24 hours a day at Woodstock, Tenn. This operation demands instrument accuracy with a minimum of maintenance and downtime. To increase instrument efficiency by preventing corrosion and costly line freezes, Grace Chemical installed a Kemp Dryer.

Kemp Requires Little Attention

Semi-automatic, the Kemp Dryer works night and day drying compressed air for instruments and pneumatic controlled valves. According to operator Charles Lewis, the Kemp unit requires a bare minimum of attention.

Kemp Dryers for Every Purpose

Kemp offers a variety of dryer models to meet all problems. Designed to dry air, gases or liquids to sub-zero dew points at a low cost, they are constructed of quality materials and embody the engineering knowledge gained from Kemp's many years of experience. Kemp Dryers are available with manual, semi-automatic, or fully automatic tower reactivation. In addition, Kemp will prescribe the proper desiccant for each drying job. If you have a problem involving the removal of water from air, gases, or liquids, contact Kemp engineers now. For complete facts and technical information, write for Bulletin D-29.



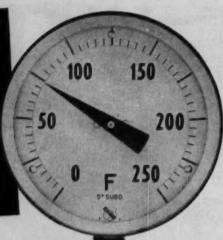


DYNAMIC DRYERS

CARBURETORS . BURNERS . FIRE CHECKS METAL MELTING UNITS . INERT GAS GENERATORS SINGEING EQUIPMENT

THE C. M. KEMP MFG. CO.
405 East Oliver Street, Baltimere 2, Maryland

"Every Angle" Design
Maxivision Accuracy
Bi-Metal Actuation



Now...all 3 in one 'American' Thermometer

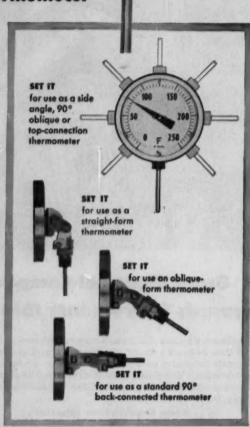
Only this new American Thermometer* gives you the three features most demanded in a dial thermometer. The "Every Angle" design allows you to install this thermometer anywhere... then angle it in the direction that provides easiest reading. The anti-parallax Maxivision dial guarantees the surest, sharpest, easiest reading. Graduations are carried on a raised ring, set close to the cover glass, with an index-type, functional pointer set at the same level. The result — no perspective effect — parallax error practically eliminated. Finally, bi-metal actuation insures high sensitivity, economy, and surety of operation.

Install the new American "Every Angle" Bi-Metal Dial Thermometer anywhere — inside or out. Its climate-proof case defies any weather condition. The full use of these thermometers in any process plant makes possible temperature readings with the same ease and facility of those of a pressure gauge. Write today for complete information. Ask for Bulletians 18.

SPECIFICATIONS

5-Inch Type 5-6060 American "Every Angle" Bi-Metal Dial Thermometer

Temperature Ranges: From minus 80° to plus 1000° F. Accuracy within 1% of range. Dial Size: 5". Scale approximately 10½" long. Bi-Metal Coil: Low mass, with single helix close to inside wall of stem assures high sensitivity. Silicone fluid dampens vibration, accelerates transfer, speeds response. Case: Stainless steel. Bezel: Threaded to case. Front: Clear, extra-heavy glass set in channeled gasket to seal case. Pointer: Functional type, adjustable from front. Stem: Lengths — 4" to 24". 18-8 stainless steel. All joints welded. Connection: Fixed, ½" NPT. Separable Sockets: Available in all materials and sizes normally required.





PHONE your Industrial Supply Distributor for experienced attention to your needs. He is always ready to help you ward off costly shut-downs through fast delivery from local stocks.

AMERICAN INDUSTRIAL INSTRUMENTS

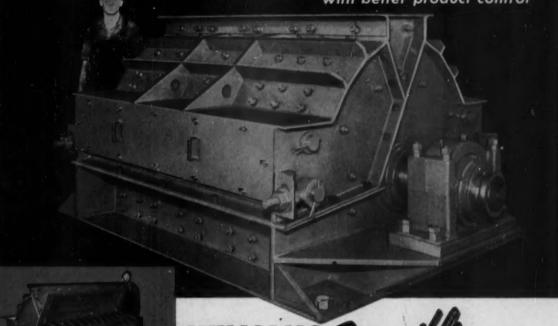


A product of MANNING, MAXWELL & MOORE, INC. STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, Stratford, Conn. 'HANCOCK' VALVES, Waterlown, Mass. 'CONSOLIDATED' SAFETY RELIEF VALVES, Tulso, Okiahoma. AIRCRAFT CONTROL PRODUCTS, Danbury & Stratford, Conn. and Inglowood, Calif. "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, Muskegon, Mich.

Lowest-Cost Crushing

with better product control





By properly controlling the forces of speed and mass in size reduction operations, Williams Impactors offer the lowest possible cost-per-ton in producing top quality materials from 2' down to 35 mesh with a minimum of fines... or much smaller where more friable products are handled. In closed circuit systems with external vibrating screens, a single Impactor promises $100\,\%$ product sizing with surprising economy, even with the most difficult specifications.

No grates are required, hence no replacement expense of these parts is necessary. Quick, uniform reduction, sizing and discharge from the mill eliminates any grinding attrition action that causes excessive wear, especially if raw materials are highly abrasive. Reversible rotation eliminates manual turning of hammers and minimizes down time. Impact blocks are also reversible which further reduces cost. Parts last up to 7 times longer than in other types of equipment. Unusually low maintenance is a feature of the Impactor.

You have much to gain in lower costs and better product quality control with an Impactor. Write for literature.

WILLIAMS PATENT CRUSHER & PULVERIZER CO. 2706 N. 9th St. St. Louis 6, Mo.

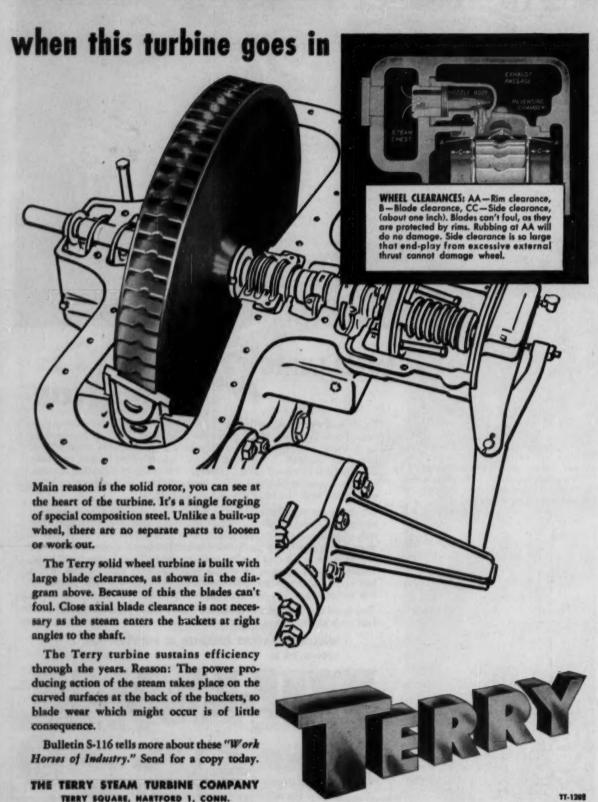
CRUSHERS GRINDERS SHREDDIRS

CRUSHERS SHREDDIRS

Hammer Mills Hulls-Seel Mills Rollser Mills Air Separators Vibrating Screens Fooders

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD.

WHY TROUBLE GOES OUT





About 1,100 tank cars are in constant service at Petro. Here some of them wait on the B&O siding for their turn at the loading racks. An advantage

of the Petro operation is its mid-continent location at the juncture of three great railroads and two major highways, one E.W., the other N.S.

Petrochemicals...

from pipeline gases

At the Petro plant—Tuscola, Illinois—an endless stream of natural gas is being separated into ethane, propane, butane and natural gasoline.

products you need

The ethane is converted into ethylene, which is in turn converted to ethyl chloride, ethyl alcohol, ether and polyethylene. U.S.I. ammonia and sulfuric acid plants next door supply and receive raw materials.

for the future

Petro can manufacture products other than these if the demand arises—products that can be made from the many raw materials available at the plant site.

in bulk quantity

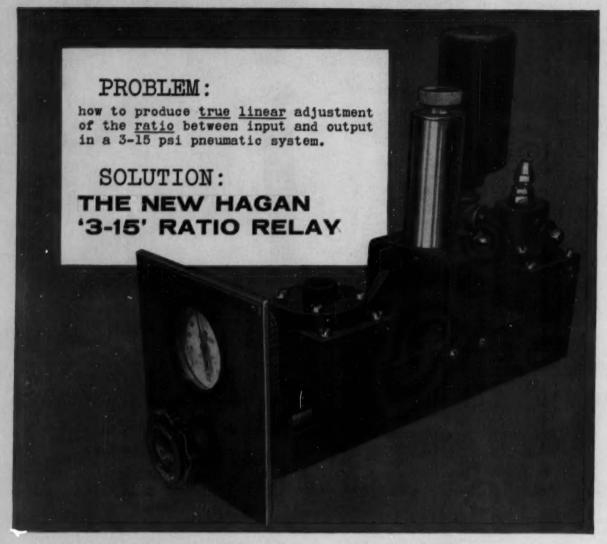
Why not add this plant to your facilities? Our engineers will be glad to discuss your long-term bulk requirements for chemicals from National Petrochemicals Corporation.

NATIONAL PETRO-CHEMICALS

CORPORATION

A joint enterprise of National Distillers Products Corporation and Panhandle Eastern Pipeline Company

99 PARK AVENUE, NEW YORK 16, N. T.



This unique Hagan device fills a long felt need in pneumatic process control systems for a relay which will permit the operator to adjust the ratio between input and output signals.

Rugged and reliable, and requiring small space, the Hagan Model '3-15' Ratio Relay produces a true linear proportional change in the output signal. Designed primarily for use with 3-15 psig signals, the '3-15' is easily adjusted to change the minimum input and output bias values to any point between zero and six psig. The actual maximum input and output signals may be any value up to 20 psig.

The Hagan '3-15' is ideally suited for any process control systems such as fuel to air ratio in combustion processes, ratio of gases in gas mixing or in the proportional feeding of chemicals. See your Hagan engineer, or write for full details. Ask for Specification Sheet SP4315.

HAGAN MODEL '3-15' RATIO RELAY

True ratioing around 3 psig input
Compatible with any signal system whose range
is between 0 and 20 psig
Simple means for altering suppressed scale setting, if desired
Mounting Plate dimensions—6¾" x 6¾"
Input range—0-20 psig
Output range—0-20 psig
Minimum Ratio setting—0.3 to 1
Maximum Ratio setting—3.75 to 1
Suppressed Scale Range (adjustable)—0-6 psig

HAGAN CORPORATION



HAGAN BUILDING, PITTSBURGH 30, PA.
Systems and Components for: Process
Control, Metallurgical Furnace Control,
Boiler Combustion Control, Aeronautical
Testing Facilities • Industrial Water Treatment • Chemicals for Water Conditioning

MAGAN SUBSIDIARIES: GALGON, INC. . HALL LABORATORIES, INC.

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Acid Pumps
Give You
LOWER
Pumping Costs





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New York Office: 1775 Broadway, New York City

True pumping economy is a reality when you install Wilfley Acid Pumps. These rugged, heavy-duty pumps give you 24-hour, trouble-free operation. Production records prove that Wilfley provides the ultimate in pumping efficiency. Available with pumping parts of the machinable alloys as well as plastic to meet all requirements.

Individual Engineering on Every Application



MAGNETIC IDEAS FROM



ERIEZ

New! HI-VI electro-permanent magnetic vibratory equipment

First complete line of electro-permanent magnetic vibratory equipment operating at 3600 CPM directly off an AC line. No rectifier needed!...just plug in. HI-VI units provide greater vibratory output with less power consumption ... give superior performance at reduced costs. Speed production. Permanently powered Alnico V magnetic element results in exclusive "double action" drive for greater productivity. Lightweight, compact, easily installed. HI-VI Vibratory Feeders give accurate, controlled feed to bulk materials ...



trolled feed to bulk materials . . . convey, spread, agitate, blend, cool, mix, etc. HI-VI Unit (Bia) Vibrators (self-adjusting) keep materials pouring freely and evenly through hoppers, bins, chutes, etc. Prevent pile-upe, arching, bridging. Write for complete HI-VI literature.

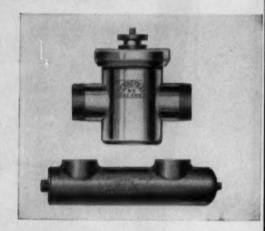


MI-POWR PLATE MAGNET PROTECTS PRODUCT PURITY. At the Newark, New Jersey, plant of the Serutan Company, a system of Eries permanent-powered magnetic separators is used to assure product purity and to protect expensive machinery from tramp iron damage. The Eries Plate Magnet shown here is installed in a gravity flow line leading from a mixer to the pellet mills, and is daily trapping unwanted pieces of tramp iron, as well as ferrous fines. The efficiency of the Eries Magnets, according to plant officials, has far surpassed expectations.

Eriez' free booklet "Magnetic Ideas" can help you. Send for it without obligation, ERIEZ MANUFACTURING COMPANY, 74J Magnet Drive, Erie, Pa. OR on your specific request Eriez factory-trained field men back by Eriez' laboratory and engineering know-how, will be happy to study your particular problem, make a plant survey and offer helpful "Magnetic Ideas".

MAGNET MOCKS MIGHTY MUSCLE-MANI

This rugged weight lifter is certainly no "97 lb, weakling" but no matter how he grunts and groans he'll never be able to lift this weight. It's held in place by a HI-POWR Alnico V magnet bolted to the floor. (The weight was finally broken from the magnet's attraction by two strong men using hardwood pry-bars). This idea of herculean power has found a practical application in industrial processing lines, where magnetic separators are used to remove dangerous tramp iron before it causes machinery damage, fires or product contamination. All Eriez Magnets are non-electric, self-contained. They operate without any wires or attachments. Their magnetic power lasts a lifetime. The first cost is the only cost.

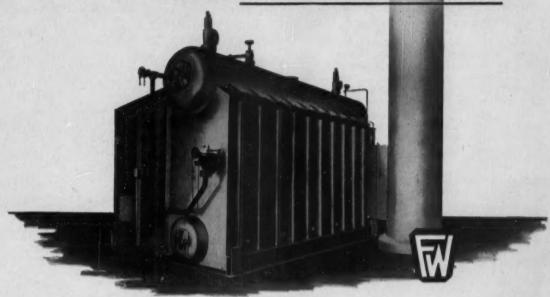


ERIEZ MAGNETIC FERROTRAPS (PIPELINE

TRAPS). Utmost protection against unwanted iron damage and iron contamination for almost all materials flowing through pipelines. New design offers three to four times more magnetic area than previous traps, effectively catches larger pieces of stray metal as well as microscopic fines. Invaluable for protecting expensive equipment; a "must" where product purity is of prime importance. Model B, (above, top) has stainless steel housing, and is available in standard or sanitary models. Model L, bronze housing, is standard model only. Ferrotraps are quickly installed, easily cleaned and can be used in any position. Withstand high pressures.



CUT STEAM-PLANT INSTALLATION AND MAINTENANCE COSTS

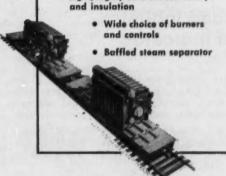


... with the NEW Foster Wheeler

PACKAGED STEAM GENERATOR

CONSTRUCTION FEATURES

- 36" steam drum and 24" water drum
- Staggered boiler tube arrangements
- Closely spaced waterwall tubes
- · Water cooled target wall
- No headers—Low circulation loss
- Light, highly efficient refractory
 and insulation



HERE IS a compact, space-saving steam generator that is completely factory assembled and shipped to you ready to set on a simple, low-cost foundation—ready for your fuel, steam and electric connections. There is only one outlet to the stack, and this has a simple, flanged connection as shown above. Extremely compact design permits access to boiler rooms through average building openings.

Low refractory maintenance is assured by the use of closely-spaced waterwall tubes and water-cooled target wall. The boiler interior is easily accessible for cleaning through a large access door in the rear furnace wall, and dusting ports are provided along the boiler bank side at intervals of not more than 42". Soot blowers can be furnished as original equipment or installed later.

Available in capacities from 10,000 to 50,000 lb/hr, the new FW Packaged Steam Generator represents the last word in modern steam plant design. For complete details, send for Bulletin PG-55-3. Foster. Wheeler Corporation, 165 Broadway, New York 6, N.Y.

FOSTER WHEELER

NEW YORK . LONDON . PARIS . ST. CATHARINES, ONT.



Here's why leaders in American Industry are using the L&N Stabilized Indicator

Quick Warm-Up-less than 60 seconds.

Fast Response—about 1.5 seconds.

Measuring Errors "Designed Out"—completely unaffected by zero drift, electrical pickup, a-c surges.

Only Two Adjustments—standardization and temperature compensation.

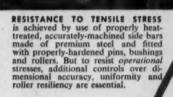
Fine Performance—limit of error, ±0.1 pH; reproducibility, ±0.02 pH.

Low Price—\$250.75 for 120 v. model; \$273.75 for 240 v. model, f.o.b. Phila. (subject to change without notice). Supplied with glass and reference electrodes, buffer, and potassium chloride solution.

Use No. 7664-A1 (120 v.) or 7666-A1 (240 v.) when ordering, or write Leeds & Northrup Co., 4916 Stenton Ave., Phila. 44, for details in Data Sheet E-96(2).



It's not just static strength..





STRENGTH OF CHAIN IN MOTION is accomplished through tensile strength plus special Link-Belt refinements. These include pitch-hole preparation, micro-finish of parts, special processing of sidebars, prelubrication and rigid quality control from initial selection of materials to final protective boxing.

dynamic strength n LINK-BELT Roller Chain that fights fatigue

N high-speed drives or heavy conveying jobs, the components of every pitch of roller chain face severe and repeated operating stresses—engagement with sprockets, shock of starting loads, centrifugal loads and others. That's why dynamic strength—ability of chain to resist these stresses—is so important. And it's built into every length of Link-Belt Precision Steel Roller Chain.

How is dynamic strength developed? In addition to Link-Belt "extras"... special design, manufacturing and processing steps provide required properties of uniformity and accuracy for long-life operation.

Talk over your roller chain needs at your nearby Link-Belt office or authorized stock-carrying distributor. Ask for Book 2457, covering this complete line of single and multiple widths, in ¼ to 3-inch standard pitch, 1 to 3-inch double pitch.

LINK-BELT gives you dynamic strength that comes from these important EXTRAS

PRE-STRESSING of multiple width chain provides uniform load distribution.





SHOT-PEENED ROLLERS have greater fatigue life, added ability to withstand impact.

CLOSER HEAT-TREAT CONTROL—coupled with rigid testing insures uniformity.





LOCK-TYPE BUSHINGS (applied on a range of sizes) end a cause of stiff chain.

LINK B-BELT

ROLLER CHAINS & SPROCKETS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



Here is Why!

You can dispense with oil filters and dust filters when you install Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

Nash Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

No oil filters. No dust filters. No internal lubrication to contaminate air handled. No internal wearing parts. No valves, pistons, or vanes. Non-pulsating pressure. Original performance constant over a long pump life. Low maintenance cost.

NASH ENGINEERING COMPANY
395 WILSON, SO. NORWALK, CONN.

At last...the solution to

really tough gas-cleaning proble

Sub-micron fumes are the really tough gas cleaning problems. These fumes cannot be economically or effectively controlled by conventional cleaning devices.

However, the Chemico P-A Venturi Scrubber is proving its success in solving these really tough problems in more than 150 commercial installations and in more than 70 pilot investigations.

The table lists some of these commercial installations. All of these really tough problems and many more are being solved with complete satisfaction to users of P-A Venturi Scrubbers.

-

PROCESS	DUST OR FUME	CAPACITY CFM
Incinerator—Flue Fed	Fly Ash	32,000
Incinerator-Sodium Disposal	Na 2O	9,000
Incinerator-Industrial	Radioactive Dust	6,000
Dry Ice & CO 2 Plants	Amine Recovery	72,400
CO 2 Gas for Process	Fly Ash	500
Boiler Flue Gas	Fly Ash & SO :	4,300
Enamel Frit Furnace	Dust & HF	11,900
H ₂ SO ₄ Concentrator	H ₂ SO ₄	49,800
Copperas Roasting	H ₂ SO ₄	34,250
Cobalt Ore Roasting	H ₂ SO ₄	65,000
Chemico Wet Type Acid Plant	H ₂ SO ₄	41,000
Chloro-Sulfonic Plant	H ₂ SO ₄	600
Phosphoric Acid Plant	H ₂ PO ₄	91,900
Phosphoric Acid Concentrator	H ₄ PO ₄	194,000
Phosphor Copper Furnace	H ₁ PO ₄	15,000
Smelting-Non-Ferrous		
Blast Furnace	Lead & Organic	12,000
Reverb. Furnace	Lead Compounds	23,500
Comb. Blast & Reverb.	Lead Compounds	7,000
Brass Furnace	Zinc Oxide	7,500
Aiax Furnace	Beryllium Fumes	4,000
Steel Plant		
Oxygen Steel Process	Iron Oxide	140,000
Blast Furnace	Coke & Iron Oxides	788,000
Zinc Sintering	Zinc Oxide	75,000
Wood Distillation	Tar Products	3,500
Na 2SiF 6 Dryer	SiF & Dusts	700
Iron Chloride Concentrator	FeCl 2 & HCL Mist	40,000
Unknown	Carbon Black	1,700
Lime Kiln	Lime & Na 2O	18,000
Detergent Spray Dryer	Chemical Fume	250,000
Furfural Residue Burner	Fly Ash	36,000
Nodulizing Kiln	Manganese & Lead	25,000
Aluminum Pot Lines	Tar Fog, Fluorides	40,000
Carbide Furnace	Metal Oxides	1,000
Asphalt Plant	Rock Dust	80,000

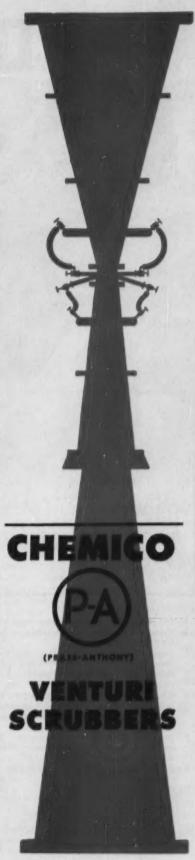
Write to our P-A Sales. Department for Bulletin M-102 describing the simple operating principle of the P-A Venturi Scrubber, and Bulletin M-103 explaining its metallurgical fume applications in the steel industry.

CHEMICAL CONSTRUCTION CORPORATION

525 WEST 43rd STREET, NEW YORK 36, N. Y.



Technical Representatives Throughout the World Telephone LOngacre 4-9400 Cable Address: CHEMICONST. N. Y.



Riller ... headquarters for

Feeders

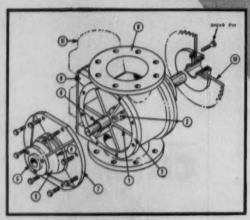
When your problem is one of feeding dry, pulverized or granular materials, why not come direct to headquarters—FULLER—designers and builders of various feeders for many uses. We have built thousands of feeders for the process industry, year in and year out, for over a quarter of a century. Many have been of special types to meet individual requirements.

Standard feeders are built of cast iron or combinations of iron and steel. When required, they can be built of special alloys.

The Fuller Roll Feeder is especially adaptable to handling of dry, pulverized materials with volumetric accuracy, without pulsations. Vane type feeders are built for use where extreme volumetric accuracy is not particularly essential. They are built with stuffing boxes and ball bearings, for vacuum, low pressure, and general purpose uses, with circular or rectangular flanges.

For complete information write for Bulletin F-5.







Description of drawing above:

- 1. Six vanes. Two vanes seal between inlet and outlet.
- 2. Tapered rotor hub. Reduces friction from trapped material between rotor and headplates.
- Integral-cast bearing brackets insure concentric bearing centers with male-female joint between headplate and feeder body.
- Bearing brackets on sides of packing glands allow free drop of packing gland leakage; prevents material from entering bearings.
- 5. Integral-shielded ball bearings; factory greased for life of bearing.
- Shouldered shaft for externally centering and maintaining alignment of rotor, resulting in equal rotor end clearances and eliminating contact between rotor and headplates.
- Heavy body walls and headplates. Rigid construction to permit smallest possible rotor clearances. Permits at least one possible re-machining after normal wear.
- Standard companion flange size and bolt circle permits connection to pipe size flanges.
- Integral cast lugs for drive provides universal mounting for any type motor reducer. Rigid drive for minimum space requirements. Eliminates drive stress between feeder and related equipment.
- 10. Shear pin coupling with simple standard bolt shear pin.
- 11. Gear motor with right angle combination drive. Can be furnished with a parallel shaft drive if desired.

FULLER COMPANY

134 Bridge St., Catasaugus, Pa.

SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION

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Remarkable PLASTISOL ...improves so many products it's an industry itself!

So versatile is plastisol (Exon 654 in the Firestone line of vinyl resins) that its uses are spreading rapidly throughout industry. All kinds of products are being made better

to sell better, with the benefits of plastisol compounds made with Exon 654.

Look at the picture above—plastisol at work! Slush molded of Exon 654, the doll acquires a natural look and feel, a washable skin. The supermarket wagon is dipcoated with Exon 654 so moisture can't rust it. Exon 654 plastisol coating makes the handbag fabric more durable, colorful, fashionable. Greases can't affect the Exon 654-coated dish drainer.

Even the car itself! It can actually cost less because plastisol reduced production costs! Assembly lines now use grappling hooks to lift the chassis because abrasion-proof plastisol coatings on the hooks prevent marring or scratching the car surface. And the car's battery and other parts were made in a plant that coated its tanks with Exon 654 so that acids wouldn't corrode them.

This remarkable plastisol, Exon 654, is just one of the many resins in industry's most complete line of versatile vinyls. It is another reason why industry looks to Firestone Exon for engineered answers to its needs.

it's made of Tirestone

because



VERSATILE VINYL RESINS

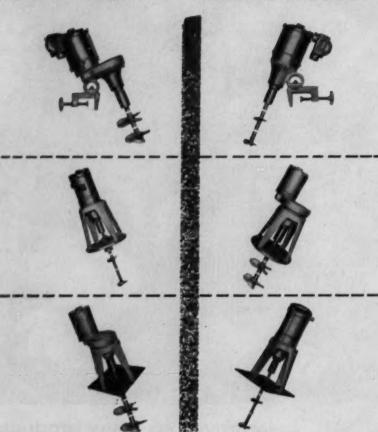
engineered answers to industry's needs

Firestone Plastics Company supplies the plastisol resin only...does not make compounds or finished products.

For complete information or technical service on the entire line of Exon resins, call or write today: CHEMICAL SALES DIVISION

FIRESTONE PLASTICS CO., DEPT. 628 M. POTTSTOWN, PA. . A DIVISION OF THE FIRESTONE TIRE & RUBBER CO.

NEW 6 WAYS TO CUT



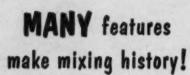
Based on years of study of all types of industrial mixing problems, Nettco Agitation Engineers have developed and perfected these long-lasting, low cost Portable and Flange Mounted Mixers — the only units available with built-in DRIP-PROOF CONSTRUCTION. They are furnished in both high speed (1800 RPM) and medium speed (420 RPM) designs — ALL with Standard NEMA vertical C flange motors. Models range from 1/6th to 2 horsepower... for portable, open tank, or closed tank installations.

FACT SHEETS FREE!

- send for your copies to New England Tank & Tower Company, 87 Tileston Street, Everett 49, Mass.







- Standard NEMA Vertical C Flange Motors, in standard speeds, and in open, totally enclosed, and explosionproof construction.
- Can be tilted in any position no oil can run into motor from speed reducer unit.
- Most efficient drive means more power to propellers from given horse-power input.
- Convertible in field from portable to flange mounts . . . from high to medium speed.
- Nettco-perfected split coupling (easy disassembly and reassembly accurate alignment quick interchange of shafts). Positive grip on shaft . . . no shaft scoring.
- Sanitary design for food and pharmaceutical applications.
- Oversized bearings for full radial load carrying capacity.



Always check your agitation needs with

NETTCO

Typical HARSHAW CATALYSTS

and How they are Used



TABLETED



EXTRUDED



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GRANULAR



POWDERED

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"HARSHAW CATALYSTS"

DEHYDROGENATION CATALYSTS

CHROME-ALUMINA—available in powder or tablet form containing various percentages of chromium axide supported on high surface area alumina—can be supplied as promoted catalyst and is also available as screened granules.

IRON-tableted iron oxide.

REFORMING CATALYSTS

MOLYBDENA-ALUMINA—supported molybdenum oxide en alumina—available as microspheres for fluid techniques, or as tablets for fixed bed application.

COBALT MOLYBDATE—a supported cobalt oxide—molybdenum exide catalyst supplied in tablet form.

NICKEL-ALUMINA—a spherical catalyst available as hard spheres measuring 1/4" so 1" diameter—used for some types of gas reforming.

DESULFURIZATION CATALYSTS

COBALT MOLYBDATE—a supported cobalt exide—molybdenum exide catalyst supplied in tablet form.

ZINC OXIDE—a pelleted zinc catalyst used in the desulfurization of

MOLYBDENUM SULFIDE—powdered and tableted molybdenum sulphide.

CHLORINATION CATALYST

COPPER—supported copper catalyst prepared and shipped as tablets or granules.

HYDROGENATION CATALYSTS

NICKEL-KIESELGUHR—supplied as unreduced, or reduced and stabilized, tablets, % " to % " diameter.

NICKEL-ALUMINA—available in tablet form containing nickel as nickel oxide on high surface area alumina, or in spherical form supported on law area, high-fired alumina.

RUFERT FLAKES—reduced nickel protected by hardened oil shipped as free-flowing flakes for hydrogenation of all glyceride and acid fats.

COPPER-CHROMIUM OXIDE—shipped as powder or tablets, stabilized or non-stabilized, with varying ratios of copper oxide to chromium exide.

NICKEL-ALUMINUM—powdered 50:50 alloy used for preparation of active nickel catalyst for low temperature hydrogenation.

CATALYSTS FOR ORGANIC SYNTHESES

ZINC CHROME—a tableted zinc oxide—chromium oxide catalyst used in the synthesis of methanol.

MERCURIC CHLORIDE—a granular catalyst consisting of mercuric chloride on active, granular carbon used in the synthesis of vinyl chloride management.

COBALT THORIA—available as powder or tablets, a thoria promoted cobalt catalyst employed in Fischer-Tropsch synthesis.

COBALT—a supported cobalt catalyst in pellet form used in the synthesis of hydrogen suffide.

DEHYDRATION CATALYST

ALUMINA—powdered and tableted aluminum oxide supplied as an active, intermediate surface area catalyst.

Whether your requirement is measured in tons or pounds Harshow can produce your catalyst exactly to your specifications of raw materials, chemical composition, and physical properties such as length, diameter, crushing strength, abrasien resistance, and but density. AND, make delivery when you want it. Call on Harshow today—for further information or technical assistance.

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Corrosive fumes and gases play havoc with "unprotected" structural steel or concrete walls and factory equipment. But the selection of a satisfactory protective coating isn't always easy. A coating that adequately protects against fume "A" may fail in a week against fume "B."

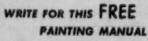
Corrosion engineers know there is no "all purpose" protective coating. Wisely they steer clear of products whose makers claim universal "acid and alkali" resistance. They have learned through bitter experience that all too frequently they end up "painting with applesauce."

The fact that Tygon Paints—first marketed in 1939—have grown increasingly popular with corrosion engineers, stems from two things:

- 1. They are GOOD PROTECTIVE COAT-INGS
- 2. WE'RE NOT AFRAID TO ADMIT THEIR LIMITATIONS

Used as they should be used and under conditions for which they are suitable, Tygon Paints will out-perform and outlast practically any coating on the market. Seventeen years have proved it.

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Tells how and where to use Tygon Paint . What primers to use to obtain best adhesion to various surfaces; how to make sure you're going to get adequate protection of minimum cost. Address The U. S. Stoneware Co., Plastics & Synthetics Division, Akren 9, Ohio.

Plastics & Synthetics Division



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·Chementator

H. T. SHARP

Chemical & Industrial Corp., Cincinnati, is now a licensor of the Prayon process for phosphoric acid.

- Pilot plant to study the modified Rheinau process for making dextrose via wood hydrolysis is being built in West Germany. It will make 500-1,000 tons of dextrose per month. Firms in five countries are reported negotiating for licenses for the process. North Carolina State College is studying a similar process in a small unit at Raleigh.
- Metal Hydrides makes the catalyst in situ in a new low-pressure polyolefin process. Sodium hydride, aluminum chloride and titanium tetrachloride react at 212 F. under a few atmospheres of ethylene pressure. A Ziegler-type catalyst forms first and, as more ethylene is added, polymerization commences.

Ion exclusion process hikes sugar yield

Ion exclusion, a separation process based on selective adsorption, is moving rapidly toward commercial use. At Rockford, Ill., a newly opened demonstration plant is showing sugar companies how this technique can recover $7\frac{1}{2}$ to 10% more crude sugar.

Developed by Ultra-Sucro Co., working with Illinois Water Treatment Co., the new technique, a modification of Dow Chemical's ion exclusion process (*Chem. Eng.*, Oct. 1952, p. 234), is expected to have great economic significance for the sugar industry.

Ultra-Sucro takes the blackstrap molasses from the second crystallization step in the sugar process and, after clarification and pretreatment, passes it over a resin bed to remove the ionic materials that inhibit further crystalization of sucrose. Sucrose recovered by the method is also bacteria-free.

Although the process uses a resin bed, it differs greatly from conventional ion exchange processes. Ions are rejected, not retained, by the high ionic concentration within the resins. Ionic materials pass quickly through the bed, while the non-ionic sucrose permeates the resin particles and moves through the bed more slowly.

Costly—and corrosive—resin regenerants aren't needed, since the sucrose can be flushed out by water. As reported earlier (*Chementator*, Apr. 1956, p. 108), the process has been tested under plant conditions.

Piloting new nitrous oxide synthesis

R. S. Aries and Associates is now readying a continuous catalytic process for nitrous oxide in its Long Island City, N. Y., pilot plant. Discovered by the University of Texas' Kenneth A. Kobe while hunting a new route to hydrazine, the new process involves controlled oxidation of ammonia with air.

Catalyst used in the process is specific for producing N_2O . Aries won't say what it is, describes it only as a metallic salt. It's said to

have a long life and is cheap enough to discard when its activity wanes.

Aries reports economical operation and high yields for the new process. The conventional N₂O process decomposes solid ammonium nitrate at about 400 F. Chief drawbacks are batch operation and need for high purity raw material. A newer process, introduced by Ohio Chemical Pacific Co. (Chementator, Feb. 1956, p. 105), continuously decomposes technical grade (83%) ammonium nitrate solution in a stainless steel retort at lower heats.

Patents on the catalytic oxidation process have been applied for in the U.S. and a number of foreign countries, and Aries expects to announce commercial availability of the process in the fall.

Chief uses of N_2O are as an anesthetic and as a propellent for food products. In addition, a nitrous oxide-carbon disulfide mixture is believed to have merit as a rocket fuel.

Borden plants to use Fischer process

The 36-million lb./yr. formaldehyde plants that Borden's Chemical Div. is now building at Kent, Wash., and Fayetteville, N. C., will use Karl Fischer's methanol oxidation process. Borden outbid a flock of competitors for exclusive rights to the process and the right to license other producers.

Though the Fischer process involves a higher capital investment than other formaldehyde processes, higher yields and lower steam consumption rates result in operating savings which reduce the payout period.

Borden anticipates a 93% yield, as compared with the national average of 82-88%. Differences in the composition of the gaseous feed, in the temperature and composition of the metallic catalyst and in the vaporization and absorption steps are responsible.

Lower steam consumption results from a novel heat exchanger design and other improvements. Borden declines to detail any of the yield-boosting differences or steam-saving improvements at this time.

Rotosorber process now on extended run

Jefferson Lake Sulphur Co. now believes that it has worked the kinks out of its new Rotosorber process for removing water and liquid hydrocarbons from natural gas. Designed to handle 40-million cu. ft. of gas daily, the process is now on an extended run at Atlantic Refining's Bayou Sale field in St. Mary Parish, La.

The process involves dehydration of wet gas and selective recovery of liquid hydrocarbons by adsorption. Two multicolumn units, one packed with activated carbon, the other with silica gel, take out the hydrocarbons.

Each unit revolves horizontally in a turntable fashion, and the columns within the unit are alternately fed with gas and purged to recover the adsorbed liquid. One unit extracts natural gasoline, the other takes out butane and propane.

Less initial investment, lower operating costs and more efficient extraction than similar processes are Jefferson's main claims for the Rotosorber.

The company planned to put the process on stream last spring, but trouble at the takeoff lines from the multicolumn units delayed it. A redesigned flexible coupling has now solved this problem.

Jefferson has also applied for a patent on the logical extension of the process—a bank of multicolumn units each recovering a specific component from the natural gas feed.

Radiation may help PVA fiber compete

Vinylon, the polyvinyl alcohol fiber that dissolves in hot water and can't stand severe ironing, will no longer be plagued by these use-limiting qualities if a new radiation treatment proves successful commercially.

Developed in Japan, the new method boosts the fiber's resistance to wet shrinkage much higher than relatively expensive chemical treatments do. Irradiated vinylon has a wet-heat resistance of 300 F. Formaldehydetreated vinylon's wet-heat resistance is about 240-240 F. (Chem. Eng., Jan. 1955, p. 108).

A variation of the same technique boosts the flow temperature of unplasticized polyvinyl chloride from 375 to 530 F.

Japanese researchers use deuteron bombardment from a cyclotron or gamma rays from a cobalt-60 source to irradiate the materials. Vinylon they subject to 400 million roetgen for a short time and then hold it at 250 F. for an hour. Unplasticized PVC gets a 200 million roetgen dose. Irradiated PVC also resists cyclohexanone and similar solvents.

Though the treatment will make both materials more useful, it is of prime impor-

(Continued on page 112)

Esso Unit Completed ... 21 days early!

To meet urgent production needs, a quick, quality job was desired on construction of a new process unit at an Esso Standard Oil Company refinery.

BMC Engineering accepted the challenge . . . and with a Key Man* in charge, put the unit on stream — at full capacity — twenty-one precious days ahead of schedule!

Speed was the need — with efficiency, of course. This was the "Precious Plus" in BMC's performance which never can be shown on blueprints — for it is the product of many intangibles. Other leading companies, too, find BMC's plus in performance of precious advantage. How else explain the unusual growth BMC is enjoying?

You need new "yardsticks" to measure the plus performance of BMC. For the abilities of this dynamic organization go far beyond what can be shown on blueprints — and it's such intangibles that add up to better plants, faster and at lower cost.

... whether your process problem is comman ar complex BMC engineers solve it with "fresh" thinking that frequently produces new efficiencies, unexpected savings.

... BMC Engineers are more than competent — most staff members are recognized authorities in their fields.

submits your proposal is alrays a BMC man who submits your proposal is alrays a BMC principal always the Key Man responsible for the execution of your job. Clients say, "This is the BMC difference that makes the difference."

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Dorr-Oliver has had 40 years' experience in the field of concentrated fertilizer production via the wet process of manufacturing phosphoric acid. Dorr-Oliver designs and builds complete plants.

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DIAMMONIUM PHOSPHATE BASED COMPOUNDS

Dorr-Oliver designs plants producing directly from 32% P_2O_5 phosphoric acid a wide variety of compounds such as 14-14-14, 14-28-14, 12-36-12, 11-48-0, 16-20-0 and 18-48-0 as hard, uniform, free-flowing granules based on mono or diammonium phosphates.

PHOSPHORIC ACID EVAPORATION

Dorr-Oliver designed vacuum evaporator stations eliminate serious scaling, reduce P_2O_5 losses to a negligible point and involve no fume problem.

TRIPLE SUPERPHOSPHATE FOR DIRECT APPLICATION

Dorr-Oliver designs plants to produce hard, uniform, free-flowing granules by its own process requiring evaporation to only 38% P₂O₅ with no need for subsequent curing.

NON-GRANULAR TRIPLE SUPERPHOSPHATE

Dorr-Oliver designs plants for producing a soft triple superphosphate with optimum characteristics for mixing and ammoniation.

MIXING AND GRANULATION

Dorr-Oliver designs plants for producing compounds in the form of hard, uniform, free-flowing granules from a variety of raw materials in solid or liquid form. tance to vinylon. Now made only in Japan, the fiber's attractive properties and potentially low price have brought it considerable attention, but its low heat resistance has restricted its use. Now trying to carve a market as a cheap substitute for natural fibers (Chem. Eng., Mar. 1955, p. 142), improved properties imparted by radiation may help vinylon to compete on merit rather than price.

AEC sums up its progress

Atomic Energy Commission's latest report to Congress notes much that's of interest to chemical engineers. Here are highlights:

• Cost of storing radioactive wastes can be cut by use of the fluid-bed techinque. Aluminum nitrate solution is sprayed into a heated, air-fluidized bed of aluminum oxide. Water evaporates and the nitrate converts to the oxide. Nonvolatile radioactive materials remain in the oxide, which has a smaller volume and it far less corrosive—hence more easily stored—than the original solution.

• Extraction of spent reactor fuel with molten metal—instead of treating it with acid and using solvent extraction to purify and reprocess the uranium—skips the troublesome fuel dissolving step. Melting the reactor fuel and separating the fission products by liquid-liquid extraction with molten metal is also being tried.

• Industry will get a chance to take part in AEC's studies of how to get usable energy from the fusion reaction of the H-bomb. In February, security wraps will be loosened enough to give several dozen firms a look at now-secret data.

 Interest in using the Ames processes for producing pure rare earth salts and metals is growing. Several companies expect to ask for licenses under AEC patents.

More lab study marks pilot plant delay

The \$250,000 pilot plant that Denver Research Institute will use to study the Aspeco oil shale process for Oil Shale Corp. is now expected to go on stream Nov. 1. Set to be completed in April, delays in equipment deliveries are blamed for slowing schedule.

In the interim, DRI has continued its study of the Swedish-developed process (Chementator, Mar. 1956, p. 104) in a 300 lb./hr. laboratory unit. One important result of this work is the finding that ceramic balls do a

better job of heat transfer in the rotary oilvaporizing kiln than the steel or alloy balls originally used.

Pound for pound, ceramic balls have a higher heat transfer ability and, for a given heat transfer requirement, both initial and operating costs are less with ceramics. But, notes DRI's Charles Prien, heat transfer coefficients per se are not higher for ceramics, since theoretically the coefficient is independent of the material.

With this point in mind, Prien and his colleagues will next try balls made of spent shale. These are thought to present attractive costcutting possibilities.

High-energy fuels spark expansions

High-energy fuels to power the fast growing missile industry are stirring a storm of expansion announcements by chemical makers. Generating the most excitement are pentaborane, decaborane and the alkyl boranes.

Boeing Aircraft plans to build a chemically powered bomber, and over half a dozen firms, including North American Aviation, United Aircraft and General Electric, are studying boron compounds as high-energy, low-weight fuels for aircraft and rockets.

Callery Chemical's recently announced \$38-million plant near Muskegee, Okla., and Olin Mathieson's planned \$36-million unit north of Niagara Falls will produce these materials—or intermediates for making them. Callery's plant will be built under a Navy contract. The Air Force will sponsor O-M's plant, but the company will also put up a smaller plant at the same site to make the same products for the Navy.

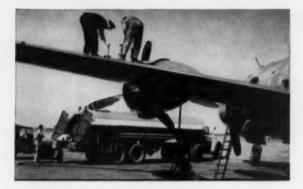
Metal Hydride's new \$51/4-million sodium borohydride plant; Stauffer Chemical's proposed 10-fold expansion of its Niagara Falls boron trichloride plant; American Potash & Chemical's one ton/day semi-commercial BCl₃ unit, just put on stream at Los Angeles; Lithium Corp.'s just-completed lithium metal and lithium deriviatives expansion and its preparation for still another capacity boost are other signs of activity in this field.

Here's how they all tie together:

Callery, a long-time producer of metallic potassium, recently patented (U.S. 2,744,810) a method of making alkali metal borohydrides by atomizing the metal in a stream of dry

(Continued on page 114)

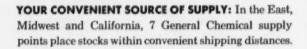
ANHYDROUS Hydrofluoric Acid for alkylation catalyst; also catalyst and fluorinating agent in many other organic and inorganic reactions.



AQUEOUS Hydrofluoric Acid for steel pickling, glass frosting and etching; also for electropolishing of metals, ore flotation, manufacture of other chemicals.



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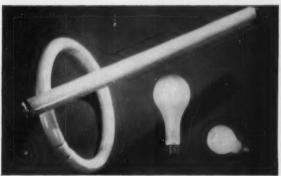
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Metal Hydride's new potassium borohydride process (U.S. 2,720,444) first makes sodium borohydride from sodium hydride and methyl borate and reacts it with potassium hydroxide. The process is in commercial production at MH's Beverly, Mass., plant—likely site of the new sodium borohydride operation.

Stauffer's expanded Niagara Falls plant will probably use a fluid-bed chlorination technique to make BCl₃. This method is believed to drastically cut equipment costs. American Potash reacts boron carbide with chlorine in a batch operation in its new unit. Need for periodically removing carbon deposits is a drawback in this method, but Ampot believes that under commercial conditions a fluid-bed technique could be developed to make the process continuous.

Ampot is reported to be dickering (jointly with one or more other firms) for a government contract to put a plant for boron-based materials in the Niagara Falls area.

Making diborane is the next step in synthesizing high-energy fuels. This can be done by reacting an alkali metal hydride (such as LiH) or an alkali borohydride (like $K_2B_2H_6$) with a boron halide (say, BCl_3) in anhydrous ether.* O-M's new facility, for example, will likely react a borohydride purchased from Metal Hydrides with BCl_3 from Stauffer.

Boron polymers—pentaborane (liquid) and decaborane (solid)—are made by heating diborane and hydrogen. Reaction of diborane with a metal alkyl, e.g. aluminum trimethyl (Chementator, Aug. 1956, p. 108; July 1956, p. 108), produces alkyl boranes.

Wyandotte shift involves Shell process

In its first major expansion outside of its Michigan home town, Wyandotte Chemical will build an \$8-million ethylene oxide plant in Louisiana. The project will also mark the first U.S. use of Shell Development's ethylene oxide process.

Purchase of 1,200 acres in Ascension Parish, south of Baton Rouge, means that the new plant will mark only the beginning of Wyandotte's building in the Gulf area. No doubt ethylene oxide will be the basis for some of these expansions. And the firm's interest in five salt domes in Louisiana will probably result in a chlorine-caustic plant at the site.

Construction of the 60-million lb./yr. ethylene oxide plant (by Lummus) will start in January and Wyandotte expects to put it on stream by the year's end. Esso's Baton Rouge refinery will supply natural gas and ethylene.

Shell Development's process catalytically oxidizes ethylene with oxygen in fixed bed reactors by a cyclic operation. Catalyst is silver on an inert carrier plus alkali or alkaline earth promotors.

Though this is the first U.S. use of the process, it is also going to be used by a Shell Chemical subsidiary, Petrochemical Ltd., in England (Chem. Eng., Aug. 1956, p. 132).

Plans set for new magnesium plant

Volume production of high purity magnesium in 1957 is the goal of Alabama Metallurgical Corp., a firm just formed by a Canadian producer of the metal, Dominion Magnesium Ltd., and Brooks & Perkins, Inc., an important U.S. metal fabricator. AMC will build a \$7-million, 10,000-tons/yr. plant near Montgomery, Ala. It will add 15% to the nation's commercial magnesium capacity.

With its eye on the growing market for magnesium in metals processing via the Kroll technique, AMC will use the ferrosilicon process, with Dominion-developed improvements, in the new plant. This process is more costly than Dow's magnesium-from-sea-water route, but it turns out a purer product.

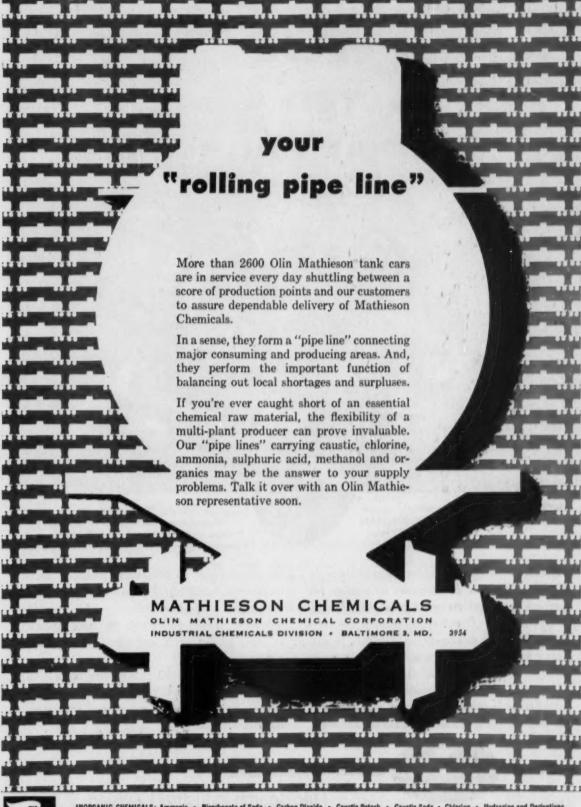
The process (Chem. & Met., Apr. 1942, p. 87) is widely used in Canada, where it was developed, and during World War II six government plants used it in this country. Currently, one of these plants (at Canaan, Conn.) is making the high purity metal for the Atomic Energy Commission.

Essentially, the ferrosilicon process reacts calcined dolomite (MgO.CaO) with ferrosilicon at 2,100-2,140 F. for several hours in steel retorts. Magnesium distills off, is condensed, melted under flux and cast into ingots.

AMC also plans to recover calcium—principally for use in thorium reduction. Production of related chemical and metallurgical products is being studied.

*A recent General Electric patent (U. S. 2,737,447) suggests that much higher yields result from carrying out this reaction in tetrahydrofuran instead of ethyl ether.

For more of WHAT'S HAPPENING..... 117





IHORGANIC CHEMICALS: Ammonia - Bicarbonate of Soda - Carbon Diexide - Caustic Potash - Caustic Soda - Chlorine - Hydrazine and Derivatives
Hyprochlorite Products - Muriatic Acid - Nitrate of Soda - Mitric Acid - Soda Ash - Sodium Chlorite Products - Sulphate of Alumina - Sulphur (Processed)
Sulphuric Acid - ORGANIC CHEMICALS: Ethylene Oxide - Ethylene Glycols - Polyethylene Glycols - Glycol Ethor Solvents - Ethylene Dichloroethylether
Formatdehyde - Methanol - Sodium Methylate - Hexamine - Ethylene Diamine - Pulyamines - Ethanolamines - Trichlorobenzene - Trichlorophene

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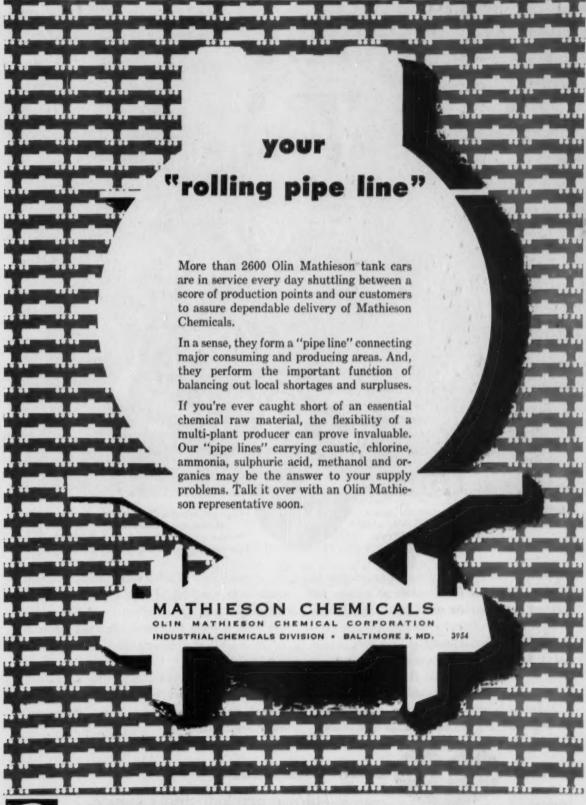
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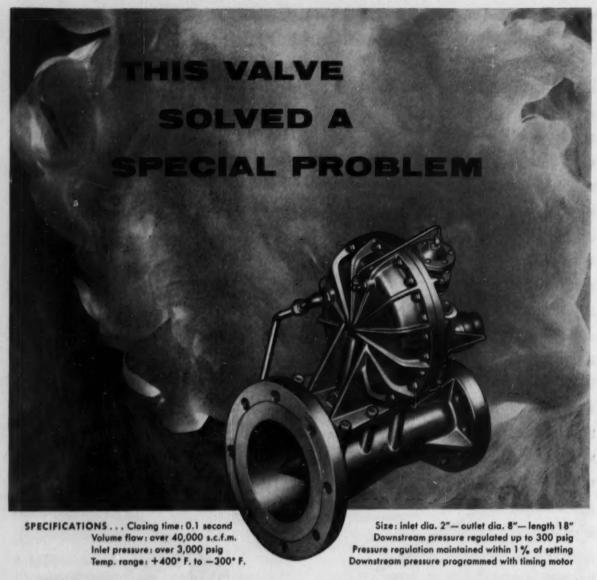
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Formaldehyda-Methacol-Sodium Methylate-Mexamine-Ethylene Diamine-Polyamines-Ethanolamines-Trichlorobenzene-Polychlorobenzene-Trichlorophenol



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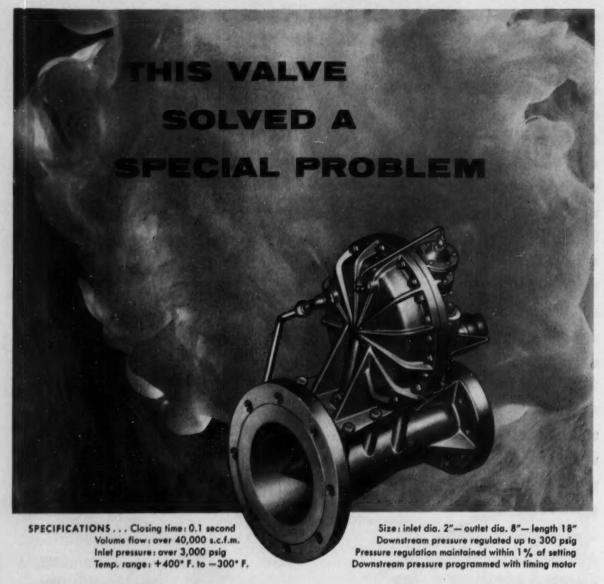
DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND SPECIALIZED INDUSTRIAL PRODUCTS

What's Happening

SEPTEMBER 1956

FEATURE NEWS

	No. 1 Problem: Don't Let Mercury Get Away	118
	In making methyl styrene, Cyanamid keeps strict tabs on the mercury catalyst. For one thing, it's costly. More important, however, is the toxicity hazard.	
	Four-Gallon Fuel Tank Powers New Reactor	122
	Industry-sponsored nuclear reactor, of the homo- geneous, water-solution type, will produce short- lived radioisotopes and study chemical effects of radiation.	
	Compressed Air Helps Pass the Salt	126
	New bulk delivery system bypasses handling and storage difficulties, cuts packaging and shipping costs.	
	How Camera Licks Engineering Problems	128
	In production of plastics, in maintenance of piping, in production of woodpulp, in design of conveyors.	
,	Unique Gasoline Project Takes Shape	134
	Gilsonite, a solid hydrocarbon mined in Utah, will yield high-octane gasoline and electrolytic-grade coke via delayed coking and two-stage reforming.	
	You Can Avoid Air Pollution	140
	Controlled dispersal of airborne effluents is usually the cheapest way. Wind-tunnel studies on small scale yield answers useful for plant design.	
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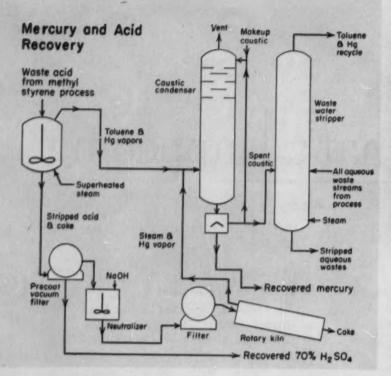
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	New bulk delivery system bypasses handling and storage difficulties, cuts packaging and shipping costs.	
	How Camera Licks Engineering Problems	128
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In making methyl styrene, Cyanamid keeps strict tabs on the mercury catalyst. For one thing, it's costly. More important, however, is the toxicity hazard.

No. 1 Problem in Making Methyl Styrene:

Commercialization of American Cyanamid's new process for making methyl styrene monomer—marked by the startup in April of a \$4.5-million, 40-million-lb./yr. unit at its Fortier plant, Avondale, La.—posed some unusual problems in process and equipment design.

Probably the toughest problem dealt with the confinement and recovery of the mercury catalyst used in the process. Confinement of the mercury is necessary from the standpoint of health and safety; you can't let the toxic stuff get away from you either as vapor or liquid. Mercury recovery is also essential from the standpoint of economics.

That's why the colored area in the right-hand flowsheet—relatively insignificant as far as the over-all manufacturing process is concerned—got so much attention from Cyanamid's researchers and Chemical Construction Corp.'s design and construction engineers.

► Why Mercury? — Cyanamid's process for making methyl sty-

rene (also called vinyl toluene) involves two unit processes—alkylation of toluene with acetylene to produce ditolyl ethane, and cracking the DTE to give methyl styrene and simultaneously regenerate half the toluene for recycling to the alkylation step.*

Catalyst for alkylation is mercuric sulfate in 95% sulfuric acid. First step in its recovery is stripping of the aqueous phase from alkylation with superheated steam at 500 F. At this temperature HgSO, readily decomposes under the reducing conditions present. And since elemental mercury exerts a vapor pressure of 96 mm. under these conditions, most of it is stripped from the waste acid and condensed in a circulating stream of caustic soda solution. ▶ Rigid Measures — Any mercury or HgSO, surviving the stripping step will end up either in the recovered 70% sulfuric acid or will be decomposed and vaporized in the gas-fired rotary kiln used to calcine the coke sludge. Mercury content of the waste 70% acid runs about 1 to 3 ppm.; this is considered OK for making fertilizer. Vapors from the coke calcining step are fed to the caustic condenser.

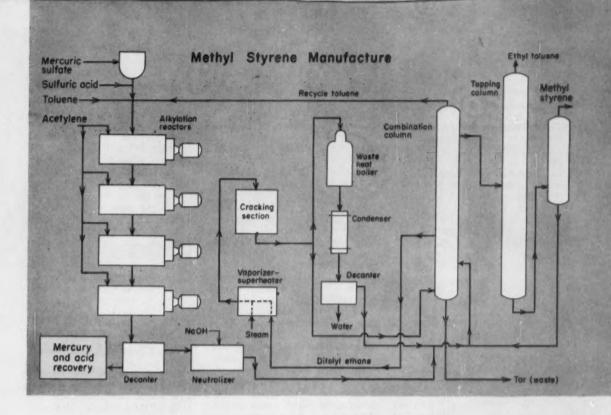
To make sure that no mercury can escape via waste process waters, all such streams must pass through a steam-stripping column before discharge.

The processing area is completely curbed and drained to a sump, so that any potential leakage or spillage can be easily brought under control. In addition, a modified commercial mercury vapor detector is used for spot testing the atmosphere in the area and inside process equipment before entering for maintenance purposes.

▶ Process Rundown—As to the manufacturing process proper, alkylation occurs in a bank of reactors of a design similar to those used by petroleum refiners for production of alkylate gasoline (see p. 120).

Acetylene is fed to each re-

^{*}Dow Chemical also makes vinyl toluene (of a different isomer mix) by ethylating toluene directly.



Don't Let Mercury Get Away

actor in parallel, while toluene, acid and catalyst pass through the reactors in series.

After separation of the aqueous phase, the alkylate, containing DTE, unreacted toluene and tar, gets a caustic wash and then goes to a complicated distillation operation which can be understood best by reference to the process flowsheet.

Pote Cracking—Stripped DTE from the distillation system goes to the cracking step. Here it is vaporized, mixed with superheated steam, and fed to several vessels containing beds of a clay catalyst supported on an inert carrier. The ditolyl ethane cracks at 500 C. to methyl styrene and toluene, with the formation of a minor amount of ethyl toluene.

The stream of cracking products is split. One portion—the magnitude of which is determined by heat-balance requirements—goes as vapor to provide boilup for the "combination" column. The rest is cooled and condensed before it gets to the same column.

▶ Distillation System — Product is purified in a series of three main distillation columns.

Function of the "combination" column is fourfold: to produce a toluene overhead for recycling to the alkylation step; to produce a DTE side stream for the cracking step; to produce a methyl styrene-ethyl toluene side stream for further refining; and to drop out tar as waste product. Two sidestream strippers operate in conjunction with the main column.

Further refining consists of topping off the ethyl toluene from the methyl styrene and rectifying the methyl styrene in a finishing column.

The topping column is 8 ft. dia. by a dizzy 186 ft. high. Since the boiling points of the three ethyl toluene isomers and three methyl styrene isomers all fall within a 12-deg. C. range, with only 4.5 C. separating the key components, these towers contain a large number of trays of a special design, featuring low pressure-drop characteristics.

▶ Why Methyl Styrene?—Cyanamid is using methyl styrene monomer to produce a whole new field of plastics. Entire output of the Avondale unit will be shipped via insulated tankcars to Cyanamid's plastics plant at Wallingford, Conn.

Cyanamid reports that moldings of polymethyl styrene are considerably better than polystyrene moldings when it comes to heat resistance. For example, moldings of PMS may be heated repeatedly at 100 C. with less than 0.3% shrinkage.

By adding 30% acrylonitrile to methyl styrene, Cyanamid gets a copolymer of equal heat resistance but having, in addition, improved toughness and resistance to scratching, chemicals and crazing.

Other potential areas in which Cyanamid hopes to push methyl styrene in competition with styrene: GR-S synthetic rubber formulations; latex and styrenated alkyd paints; and paper, textile and polyesterresin applications.

In view of styrene's recent price drop, the battle won't be easy. But you can bet that Cyanamid will be in there pitching to find outlets for its methyl styrene.

Engineering Center To Stay in New York

The 39th-40th St. site in New York will continue as the address of the Engineering Societies Center. It is already serving four major engineering societies, to which the American Institute of Chemical Engineers will soon be added.

Plans are being made for a new and enlarged building. If rebuilding at the old site proves impractical, a comparable site will be sought in midtown New York.

Canada-South Paper War Shifts Both Ways

Province of Saskatchewan is about to get its first pulp mill, a 600-ton/day unit which will be one of the largest in Canada. But the province of British Columbia will probably lose to

the southern United States a mill originally scheduled for Kitimat by Powell River Co.

The \$55-million mill in Saskatchewan will be completed in 1958 near Prince Albert by Waskasieu Forest Products Ltd. Construction program includes erection of a chlorine plant and a railway network.

Powell River spokesman, announcing that start of construction of the Kitimat mill is now quite uncertain, added that his company was actively studying possibilities in the South.

Western industry observers saw in his words a sharp warning that B. C. may soon be fighting hard to lure new mills in the face of three substantial new tax burdens. The province levies 5% sales tax on material and equipment for the mill to start with, taxes logging profits by 10% and leases and licenses at 1%, whereas the United States government allows generous tax writeoffs for the industry.

In the South a pulp mill can be built for about 30% less than a comparable one in B. C. Yellow pine pulp logs are delivered to a Southern mill by independent logging contractors at \$36 per thousand board feet; comparable hemlock in B. C. costs \$49 per thousand. Roads can be built in the South, where needed, for \$1,000 per mile, instead of the average \$25,000 per mile in B. C.

A new paper mill which the South is sure to get has been announced by Hudson Pulp and Paper Corp. A \$25-million newsprint mill of 100,000 tons/yr. capacity will be brought into production in 1958 at Palatka, Fla.

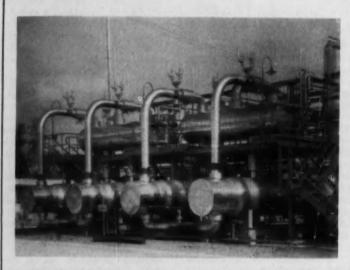
Instruments Meeting Woos Chemical Engineers

Collection of papers to be presented at this year's Instrument-Automation Conference and Exhibit is thickly laced with subjects of practical interest to chemical engineers. A sampling of titles: Dynamics of a Chemical Reaction; Automatic Control of a Heat Exchanger; Mass Spectrometers in Process Control; Gas Chromatography in Plant Streams; Radiological Gas Analyzer for Ammonia Plant Streams; Frequency Response Analysis of a Fractionating Column.

Exhibit and conference will be held at the New York Coliseum, September 17-21.

Wanted: More Sources of Solar Energy Data

Lack of solar radiation data from a sufficient number of locations throughout the United States is hindering progress of the American Society of Heating and Air Conditioning Engineers' committee charged with creating a central data pool for the use of design engineers in heating and air conditioning work, in heat pump design, solar engines, etc. Also needed: Suggestions for the development of a simple, rugged, low-cost solar radiation intensity-measuring instrument. Chemical Engineering readers who can contribute should contact J. B. Graham, Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.



Alkylation Reactors Combine Tolulene, Acetylene

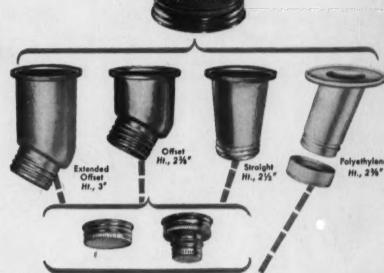
These four reactors carry out the first step in American Cyanamid's synthesis of methyl styrene, forming the intermediate, ditolyl ethane (see preceding story). Inside each is a centrally located, horizontal draft tube through which the reactants—

toluene, acetylene, sulfuric acid and mercuric sulfate catalyst circulate at high velocity, driven by a propellor agitator directconnected to a 50-hp., 1,200-rpm. motor. Temperature is controlled in the vicinity of 0 C. by bundles of U-tubes inside the draft tubes.



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Specify the Tri-Sure* 21/4" UV Nozzle and dust cap to your supplier. Then you may order from us any of these Tri-Sure Reversible Assemblies-to meet the needs of various products and markets. The 21/4" UV Screw Cap and instruction disc assembly are standard for these UV Spouts: extended offset, offset, straight spouts and polyethylene. Spout caps available for all spouts -reducer caps for metal spouts. The ease of reversal of the spout by the shipper or his customer is proving popular everywhere.

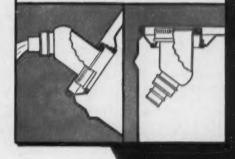
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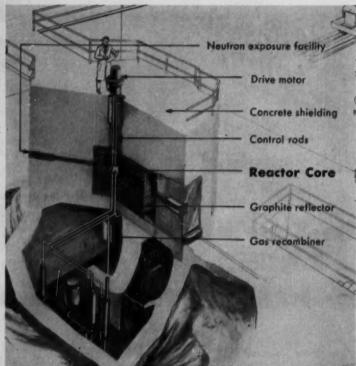


Spout reverses for

easy shipping

pouring . . . stacking





Four-Gallon Fuel Tank Powers New Reactor

Industry-sponsored nuclear reactor, of the homogeneous, water-solution type, will produce short-lived radioisotopes and study chemical effects of radiation.

At long last private industry gets to explore and exploit the wonders of the atom with its own nuclear reactor—free of security restrictions and military competition.

On June 28 Armour Research Foundation, Chicago, triggered its industry-financed, Atomics International-built, 50-kw. reactor. Target: To beam the reactor's powerful radiation streams on industrial problems.

ARF and the sponsoring industry group picked for its experimental reactor a design quite different from most other reactors built to date—the homogeneous type, using a dilute solution of uranyl sulfate in water as a combination fuelmoderator. Many nuclear experts look to this relatively simple design—despite major corrosion problems—as the reactor of the future.

While industry eyed its reactor's unveiling on Chicago's near Southside it also listened to echoes from the Loop. For there, a few days before ARF went critical, the American Nuclear Society met and swapped notes on advances in reactor technology.

Chemical Industry Backing— The chemical industry staked out a strong claim to the rewards expected to be spawned by ARF's three-year program. Of the companies lined up behind the reactor (each pitched in \$20,000 to help build and launch the \$700,000 project, with ARF picking up the balance of the check), almost half classify as operating in the chemical process field.*

Chemical people are backing this reactor program because, as R. F. Humphries, ARF's program director, points out, "The reactor is not intended for the generation of electrical power, nor for research on reactors themselves." Rather, its high neutron flux and gamma-ray radiation, he stresses, will be focused on projects that the chemical process industry finds valuable:

• Production of short-lived radioisotopes for tracer studies of fluid flow, materials transfer, mixing, etc. Short half-lives prevent long-term contamina-

^{*}Among them: Victor, Armour, Dewey & Almy, Ell Lilly, Firestone, Keilogg, Kimberly-Clark, Universal Oil Products, General Portland Cement.

RCI FORMALDEHYDE RCI PHENOL RCI GLYCERINE RCI PHTHALIC ANHYDRIDE RCI RCI PENTAERYTHRITOL PENTACHLOROPHENOL RCI SODIUM PLASTICIZERS MALEIC ANHYDRIDE Still running on the same platform: high quality and fast delivery!

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REICHHOLD

REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N.Y.

CHEMICAL ENGINEERING—September 1956

tion but, rapidly dying, preclude long-distance shipments. The new reactor makes radioisotopes available for on-the-spot indus-

trial investigations.

· Studies of radiation effects on chemical reactions, plastics, etc. Irradiated polyethylene and radiation-sterilized pharmaceuticals represent two of these effects that have already made a commercial mark. Multilevel Safety-To safely set the reactor facility smack in the middle of Illinois Tech's busy campus, Atomics International (a division of North American Aviation Co.), Canoga Park, Calif., bedded the fission plant in three protective levels.

All three-a closed plumbing system, a metallic envelope around the pile, the airtight building housing the facilitymust be pierced simultaneously before "hot" particles could escape to the neighborhood.

Just a Chemical Plant Viewed simply as a process in which matter undergoes change in composition, a nuclear reactor can be regarded as a chemical plant, designed and operated according to chemical engineering principles.

Ruilding blocks of ARF's "plant" are the homogeneous, liquid-phase, water-cooled reactor and facilities for feeding raw materials, removing products and refluxing vapors. Operations involve heat transfer, fluid flow, vapor-phase catalysis and

reaction-rate control.

A spherical, 1-ft.-dia. stainless steel core tank lies at the heart of the plant, holds the reaction mass-1,000 g. of enriched uranium as a 4-gal. water solution of uranyl sulfate (UO,SO,). It provides the critical configuration and volume to set the chain reaction hum-ming. Water, the moderator, slows down the flight of neutrons, improves the chance of fission when they strike atoms of the fuel, uranyl sulfate.

From Regulation to Scram-Four boron carbide stainless steel-encased rods, fitted vertically into the core, control the rate of fission by absorbing neutrons, clipping links out of the reaction chain. Before startup the rods are in the mass. then are withdrawn to put the plant on stream.

Hooked to the drive system via electromagnets, the rods "scram" the reactor-cut it off in an emergency—when the magnets are de-energized. One rod, driving through a servo motor, automatically regulates the power level during opera-

American Nuclear Society heard another reactor control system described by Westinghouse engineers that eliminates control rods. It makes use of the fact that, as the reaction speeds up, more moderator water is boiled off. When the steam is carried away through chambers provided in the pile moderator water density falls, neutron speed soars. Result: Sliced number of fission captures, slowed reaction, dropped

Radiolyzed hydrogen and oxygen, water vapor and gaseous fission products pass from the core to the gas-handling system. A stainless steel cooling coil, nestled in the core tank, circulates distilled water and carries away the heat of reaction. And the coveted neutron flux and gamma radiation is tapped through 17 ports and tubes that reach to the core.

Making Water-Key item of the gas-handling system is the recombiner tank. It's filled with platinum-coated alumina cylinders, fitted with an electrical heater to maintain temperature above 100 C. Radiolyzed H, and Or recombine to water vapor, condense in a distilled-water

exchanger.

Los Alamos scientists reported to the ANS that a reaction mass of uranium dioxide in phosphoric acid solution operates at temperatures up to 800 F. and vapor pressures below 1,000 psi. Under those conditions the gases will recombine without use of a catalyst.

Distilled water from the core exchanger gives up the reaction heat to city water in the main exchanger. Since no radiation contact occurs in this unit, the

heat can be dumped through city sewage without discharging radioactivity.

A safe-geometry fuel storage tank, designed for subcriticality, uses an oxygen pressurizing system to fill and drain the core. Since uranyl sulfate has a long use-life-longer than the initial three-year program-disposal of exhausted fuel doesn't pose a

tough waste problem.

Blocks Build a Pile—Marking nuclear reactors apart from the usual chemical plants are the special structures required to contain them safely. A graphite-lined aluminum cylinder surrounds ARF's core. It is housed in a graphite-block rectangular prism enclosed by a steel shielding tank. This assembly, called the reflector, concentrates neutron activity to the reactor core

The subpile room below the reflector holds the accessory equipment, and a 5-ft.-thick concrete envelope contains the entire facility. And the airtight building is kept at a negative pressure to further insure that radiation spillage will not leak

into Chicago.

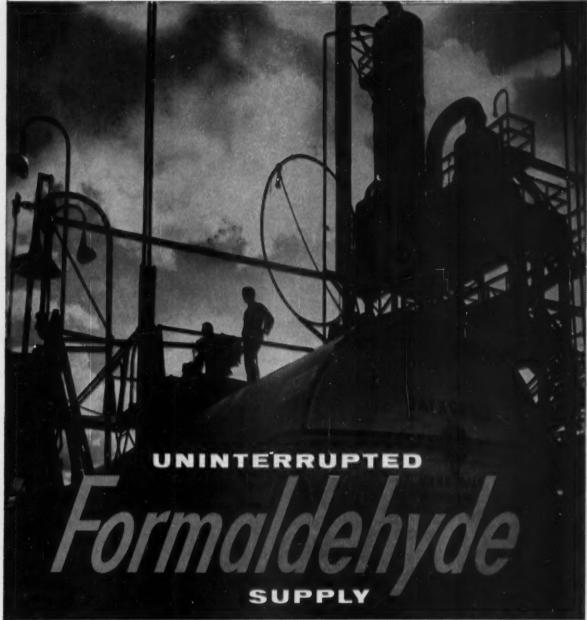
New Uranium Capacity. **New Fabrication Method**

Vitro Rare Metals Co. plans to put a \$1-million commercial primary uranium processing plant into production early next year. To be located at Canonsburg, Pa., the new setup will permit technical and reagent-grade chemical production, and milling and processing of uranium, particularly the residues.

Tube Reducing Corp, Wallington, N. J., reports that it has overcome the usual difficulties of cold-working uranium, titanium, zirconium and their alloys. Rough, nonuniform tubular extrusions fed to the company's "Rockriting" machines become long, precision-sized cylinders with a high surface finish.

These metals, when coldworked by conventional methods, tend to gall or seize. According to Tube Reducing, its machines eliminate the need for vacuum annealing, pickling and trimming operations and reduce

scrap loss.



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When you buy formaldehyde from Allied Chemical, you can be sure of steady supply — and purity. Because Allied produces the basic raw material, methanol, right at the same plant where the formaldehyde is made.

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Compressed Air Helps Pass the Salt

New bulk delivery system bypasses handling and storage difficulties, cuts packaging and shipping costs.

Everyone benefits from Imperial Chemical Industries' new streamlined bulk delivery of pure dried vacuum (PDV) salt in Britain.

New delivery trucks, equipped with pressurized tanks and air compressors (like the one pictured above), blow PDV salt directly into the customers' storage silos or saturators, eliminate elevators, conveyors and manual handling.

► Air Has Advantages—ICI lists the following attractions of the new delivery system:

 Cheapest way of "packaging" PDV. The cost to ICI of bags, filling, stitching and handling at its Winsford Works is eliminated.

• Customers save in handling equipment and costs, floor storage space.

 Most hygienic way of delivering and handling salt for ultimate use in foods.

 Storage sites can be conveniently located for direct delivery on users' premises.

The new trucks, each with a load capacity of 14 tons, can discharge a full load of salt in one hour. Compressed air blows the salt through a 4-in. pipeline to a height of 40 ft. along a horizontal distance of 30 ft. Greater heights and distances can be achieved at a lower discharge rate.

► Small Consumers Benefit — Advantages of the new delivery system apply to small as well as to large users of PDV.

Until recently, only large users took bulk shipments of PDV. These shipments were delivered in enclosed bottom-discharge hopper vehicles. The majority of users, to avoid having to provide necessary underground bins and elevators, took bagged salt instead. Compressed-air delivery now enables them to store above ground and take salt installments by gravity flow.

Salt to be used entirely as brine can be made and stored simply by using a wet storage tank or saturator charged directly from the delivery vehicle.

New Process Yields Cl-Free Plant Exhaust

Gradual venting of gases from equipment for liquefying chlorine often results in emission of enough chlorine to make plant exhaust harmful to plant and animal life. Hooker Electrochemical Co., Niagara Falls, has just patented and offered for license a method for purifying exhaust by recovering the chlorine. This is accomplished by preferential absorption into water at high pressures.

The process is desirable for use at plants where "lean" chlorine is not being used in the manufacture of various chlorinated products. Hooker has been using it for some time at its Tacoma, Wash., and Montague, Mich., plants.

U. S. Plants Try Range Of Ways to Linear Poly

Two low-pressure polyethylene plants, one at Institute, W. Va., and one at Seadrift, Tex., will be built by Union Carbide and Carbon Corp. The new facilities will be equipped to produce polyethylene not only by the Ziegler and Phillips processes, for which Carbide has been licensed, but also by improved methods developed in the company's own laboratories.

The two plants will have a combined rated annual capacity of 55 million lb. The unit at Institute is scheduled for completion in the first quarter of 1957; the Seadrift unit, a few months later.

Texas Eastman, too, will build a linear polyethylene unit for semicommercial production via Standard Oil of Indiana's newly developed process (*Chem. Eng.*, July 1956, p. 108).

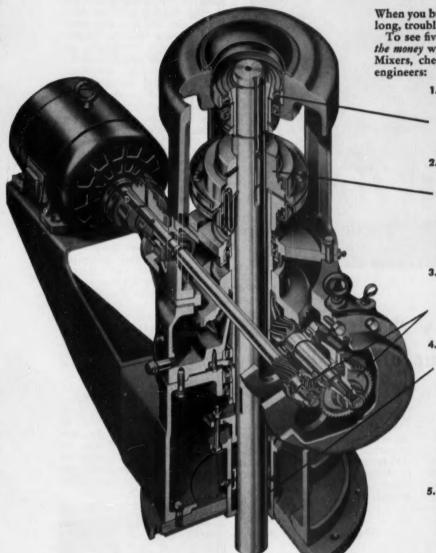
New Use Boosts Gilsonite Output

With the introduction of a new use for gilsonite as underground pipe insulation, G. S. Ziegler and Co., New York, has increased production of its Utah mines and its New Market, N. J., processing facilities.

To produce the new gilsonite insulation, various melting-point grades and sizes of the natural hydrocarbon are blended so that, when steam is first introduced to the pipe, the mixture fuses to the outside wall. A thick protective coating, requiring no maintenance, is formed.

Called Insul-ite, it affords water, acid and alkali resistance and low-heat-loss insulation. Application is simply a matter of filling in the area around the pipes with Insul-ite instead of earth.

Get these extra years of fluid mixing built into every Lightnin Mixer you buy



HERE'S JUST ONE of several hundred standard power-speed com-binations you can buy in Series "E" LIGHTNIN Mixers. This double reduction assembly provides up to 8 interchangeable mixing speeds, from 68 to 280 RPM. It converts easily to single or triple reduction for a total range of 16 standard speeds.

When you buy a mixer for fluids, you're banking on long, trouble-free service. Are you getting it?

To see five specific ways you get more mixing for the money when you specify turbine-type LIGHTNIN Mixers, check these practical questions asked by

- 1. Can I remove and replace the mixer shaft easily? Yes. You can remove a LIGHTNIN Mixer shaft upward or downward, easily and safely. This adapter-type fixed bearing assembly grips and centers the mixer shaft, realigning it accurately when you replace
- 2. What if the impeller accidentally whacks What it the impeller decidentally whacks something in the tank? Are gears protected? Gears are fully protected. This flexible coupling absorbs normal and abnormal shaft flexures. Coupling acts as a mechanical "fuse" between the mixer shaft and hollow drive quill. Mixer shaft is suspended on separate ball bearings independent of the speed reducer. The quill surrounds the shaft like a sleeve, but does not touch it. Shock loads on the shaft can prever reach the gears. loads on the shaft can never reach the gears.
- 3. Can I change mixing speed later if process requires it? Yes—provided the new speed doesn't increase mixing load beyond the mixer's rated capacity. These change gears permit quick, simple interchange of as many as 16 standard speeds, from 16.5 to 420 PDM.
- How can I cut cost of pressure or vacuum mixing? Two ways. This easy-to-service stuffing box runs longer between packing changes, because it's integral with the mixer mounting flange—aligned as a unit with the

mounting flange—aligned as a unit with the shaft bearings for true, steady running.

And now, you can end stuffing-box maintenance for good—with the easy-to-change LIGHTNIN rotary mechanical seal. The seal, not shown here, takes the place of a stuffing box. It stops leakage, runs for years without adjustment. Yet you can replace it in minutes if you ever need to—without dismantling the mixer, without need for out dismantling the mixer, without need for special skills.

5. Can I change this mixer from one tank to another without costly special construction? Certainly. You can switch a LIGHTNIN from open-tank to closed-tank mounting, from top entering to bottom entering, and vice versa, and adapt it for low-headroom installation. You can make any of these changes using standard stock components.

Only the LIGHTNIN drive gives you flexibility like this, to

Only the LIGHTNIN drive gives you flexibility like this, to keep your mixing costs low over the years.

And every LIGHTNIN Mixer you buy is guaranteed, unconditionally, to do the mixing job for which it is recommended.

Ask your LIGHTNIN representative (listed in Chemical Engineering Catalog) to explain how you can get extra years of fluid mixing, at low mixing cost. Or ask us by mail.

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- B-108 Portable: 1/4 to 3 HP
- B-104 Side entering: 1 to 25 HP
- ☐ B-112 Laboratory and small-batch production types
- ☐ B-109 Condensed catalog showing all types
- ☐ B-111 Quick-change rotary mechanical seals for pressure and vacuum mixing
- B-107 Data sheet for figuring mixer requirements

Check, clip, and mail with your name, title, company address to:

MIXING EQUIPMENT Co., Inc., 128-J Mt. Read Blvd., Rochester 11, N.Y. In Canada: Greey Mixing Equipment, Ltd., Toronto 10, Ont.



How Ingenuity With Camera Licks Engineering Problems

What you see in the picture above is a good example of the various ways in which chemical engineers today are making greater use of photography as an actual working engineering tool

Engineers and scientists have long appreciated the value of photography as a research and analytical tool in the laboratory. Other industrial uses of the camera have centered largely about less technical applications in advertising and public relations, operator training and time studies, safety propaganda and reports to management.

During recent years, however, chemical engineers have begun to see in photographing a great untapped potential tool for saving time and money in such technical fields as design, production and maintenance.

Saves Drafting Time—Parco Co. last year announced a new use for photography in plant design. It involves a special method of photography scale models to produce the equiva-

lent of conventional orthographic drawings.

And today engineers are learning more about the value of ordinary picture-taking as a tool in making actual plant operations more efficient. They're using uncomplicated photographic techniques to:

• Improve process performance.

• Pinpoint flaws in equipment.

Simplify maintenance procedures.

In Production of Plastics

At Monsanto, in Springfield, Mass., engineers cite the job of continuous winding of plastic film as one of their major challenges. This material, which has the consistency of a rubber band, must be wound uniformly on spools. The engineering development group—assigned the job of evolving new equipment and process techniques—uses photography to slow down or "freeze" the swift winding operations for evaluation.

At left, Dow Chemical's Bill Shetzley, who heads up the firm's photographic department, lets a camera point out the ways to better plastic moldings.

Until recently, data on Dow's injection - molding operations were acquired by recording temperatures and pressures mechanically during the molding cycle and then examining the finished result. No one, however, had ever seen exactly what took place within the steel walls of the mold.

A lot was seen and learned, though, when Shetzley began taking motion pictures of the operation at 8-64 frames/sec. To do it, Dow engineers designed a mold with special walls of tempered glass instead of steel. Light was projected through one side, and a mirror set up at a right angle to the mold proper made it possible to view the interior of the mold from the opposite side.

The films pointed out the need for adjustments in the size of the mold's gate and in the molding pressures in order to avoid surface blemishes caused by small jets of material which cooled too rapidly. What's more, the pictures showed the mold designer where inserts could be placed in relation to the flow to minimize the formation of defects—"weld lines" and air pockets caused when the plastic flowed around an obstruction.



In Maintenance of Piping

Maintenance men, too, now realize that photography can be a real aid in complex repair jobs.

At Shell Oil, engineers take pictures of underground piping installations near a loading ter-

Johns-Manville organizes to give you better insulation service

New and separate insulations division created to provide industry greatly improved Sales and Engineering service to meet modern problems

• Johns-Manville is now concentrating all industrial insulation operations within a new, fully integrated insulations division. This greater specialization makes possible the most complete insulation service available to industry. It consists of—



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Insulation Engineers—Backing up the J-M salesman on every job is the J-M insulation engineer. He is primarily concerned with solving insulation problems. He recommends the economic thickness of insulation, as well as the

proper finishes, weatherproofing and securement. His highly specialized knowledge makes possible an intelligent recognition and handling of your individual insulation requirements.



Insulation Contract Units... Fully aware that no insulation is better than the man who applies it, the J-M Insulation Contractor makes care and skill in the scientific application of Johns-Manville insulations his stock in trade. He maintains a complete crew of

estimators and mechanics trained in J-M application techniques. He is ready to give you fast, efficient service on any insulation job—large or small. Proud of his reputation for integrity in his own community, the J-M Insulation Contractor merits your complete confidence.



Complete Range of Products— In this day of exacting temperature control, the need for specific insulations for specific services is greater than ever before. Recognizing this, Johns-Manville manufactures insulations for every industrial requirement. Produced

from the finest grades of asbestos, magnesium carbonate, diatomaceous silica, refractory clays and ceramic fibers, they are designed to afford maximum insulating effectiveness and durability at operating temperatures ranging from minus 300F to plus 3000F.



Extensive Research Facilities—At Manville, New Jersey, Johns-Manville maintains the world's most completely equipped insulation laboratory. Here insulation scientists are engaged in a continuous program of developing new and better insulating ma-

terials. In addition, their technical knowledge is always available to J-M customers whose insulation problems require special study.



Experienced Management—At headquarters as well as in the field, management of the new insulations division consists of men who, in line with J-M's promotion-from-within policy, are insulation veterans. With a realistic grasp of customers' needs, they are alert to new and better ways

to serve you . . . now, and in the future.

On Your Next Insulation Job—Whether your next insulation job is big or little, simple or complex, let Johns-Manville handle it for you. Just call your nearest J-M sales office, or write direct to Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario. Chances are, you'll be glad you did!

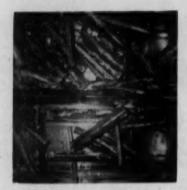


Johns-Manville

MATERIALS ENGINEERING APPLICATION

minal before pipes are buried and covered with paving. This way, maintenance men don't have to rely on complicated blueprints alone when repairs are needed.

Sinclair Oil's engineers take present condition photos, showing recent changes made in piping systems, to supplement outdated drawings. Thus the job of making further alterations is speeded up while the cost—compared to the expense of making new blueprints—is relatively slight.



In Production of Woodpulp

The headache of trying to keep track of exactly how much wood is carried along on moving conveyors is no longer a problem at Canadian International Paper Co.'s mill at La Tuque, Que.

The problem: Wood—in large quantities—had to be inventoried on moving conveyors as it passed to the groundwood mill or entered the woodroom for chipping. At these busy areas it was impossible to halt operations periodically for a count.

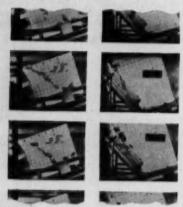
In the past, various measuring devices—vibration recorders, photoelectric counters, mechanical counters and even five or so human counters—had all proved incapable of coming up with a fairly accurate total.

Now, the mill has a camera set up as an integral part of its operation. Mounted above the conveyor and pointed directly at it, the camera is set to take periodic "glimpses" of the wood as it moves along. From these samplings, an engineer can estimate the actual total volume.

No Interference—The operation has many advantages. There is no interference with the continuous flow of wood. The count can be checked and rechecked at leisure. Random sampling makes statistical analysis possible. The equipment is relatively inexpensive and is neither difficult to install nor to operate.

....

What's more, most of the drawbacks of other methods are eliminated. A passing moth or log chip can't dictate false amounts to the camera lens as it did to photoelectric equipment. Two bolts close together don't register as one, as they often did on a mechanical counter. Volume changes are now easily detected, while they had not registered at all on a vibration recorder. And, above all, four or five men need not be tied up doing the job; one man does the counting for both day and night shifts.



In Design of Conveyors

High-speed photography pointed out the best possible new design for a conveyor transfer point at Tennessee Coal & Iron's Concord coal mine, Bessemer, Ala.

When it was set up, the mine slope conveyor represented the largest single belt installation ever made with respect to belt horsepower and total lift. (The belt—2,449 ft. long with a lift of 729 ft.—handles 800 tons of mine run per hr.) After several years' operation, signs of wear showed up, and the prospect of having to replace the belt too soon threatened the good economy of the operation.

Initially, the operation was set up like this: Coal was loaded onto a short (center) "buffer" conveyor belt, which in turn loaded the material onto the main slope conveyor. Wear on the main slope belt, theoretically, could be kept at a minimum by maintaining an equal speed between material sliding on the belt and the speed of the main belt itself. To do this, both belts were run at the same speed, the drop between the belts was kept at a minimum, and a workable transfer chute was designed.

▶ Optimum Belt Speeds — One factor—the supposed advantage of operating the belts at equal speeds—was refuted by high-speed camera studies of the transfer point design. Motions and events which zipped along at speeds too swift for human perception were "frozen" for observation by the camera.

The large number of films taken revealed, primarily, a scuffing action on the main belt cover. In an attempt to effect a smoother transfer of material, various new setups were put to the camera test. After varying belt-to-belt distances, the speed of delivery of material, the shape, slant and length of the chute (which directs the material from one belt to the other), and other variables, the camera led to an optimum design.

Dow Moves to Buy Bay Refining

By taking an option to buy Bay Refining and Bay Pipe Line Corp. in Michigan, Dow joins the growing number of chemical firms which have made moves to insure their raw material position in the petrochemical field.

Union Carbide and Monsanto have recently made similar moves. Carbide signed a long-term contract with Commonwealth Oil Refining Co. to supply refinery gas from its new Ponce, Puerto Rico, refinery to a newly formed Carbide subsidiary. The buyer, Union Carbide Caribe, Inc., reportedly will build a \$28.5-million ethylene glycol chemical plant adjacent to the refinery by 1957.

Monsanto just acquired 480

the



... the more exacting workmanship and knowledge required to build complicated welded steel plate structures. The 8-ft. diam. by 80-ft. CO: absorber tower shown above is an example. This structure was built by CB&I to exacting specifications under contract from Foster Wheeler Corporation for the Grace Chemical Company at Woodstock, Tennessee.

CB&I is a specialist. Their experience, ability and facilities will provide you with the best when your requirements are the greatest. Write our nearest office for further information.



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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

acres of oil land from the New Mexico land commission. And last year, the company bought Lion Oil Co., mostly to secure a source of ammonia.

In its negotiations with Bay Refining, Dow is after a source of ethylene. Plans are to build a plant for petrochemicals production on property it owns adjacent to the Bay refinery at Bay City, Mich.

Davison Starts Up Big Rare Earth Unit

A \$2-million plant to process monazite sand into rare earths and thorium has just been completed by Davison Chemical Co. and its affiliate, Rare Earths, Inc., at Curtis Bay, Md. With a processing capacity of from 15 to 25 tons/day of monazite sand, the plant is said to be the largest of its kind in existence.

New process used at the plant integrates with Davison's large production of sulfuric acid at Curtis Bay. Monazite, a phosphate rock, is ground in ball mill, automatically batchweighed, then conveyed to special reactors where it is heated with sulfuric acid. Rare earth metals remain insoluble in this sulfuric-phosphoric acid. But after removal from the concentrated acids, they are dissolved in cold water and freed from other metallic salts by sedimentation, filtration and precipitation, then converted to the appropriate finished product. Tonnage quantities are produced of rare earth salts, including oxides, fluorides and sulfates, as well as cerium and thorium compounds.

Private Power Plant Signed for AEC Aid

Holding a new contract for AEC aid, Yankee Atomic Electric Co. will build and operate a pressurized-light-water cooled and moderated reactor and electricity-generating equipment capable of producing at least 134,000 kw. of electricity. Fuel elements will be made of uranium oxide clad in stainless steel.

Building of the \$34.5-million plant, to be located in Rowe,

Mass., will be financed by the company. AEC will underwrite \$5-million and perform \$1-million worth of the research and development work required for the plant.

The contract provides that spent fuel elements from this project will be processed in accordance with the policies and prices of the commission which are in effect at the time processing is required. This is the first contract to be concluded under the commission's Power Demonstration Reactor Program, which was established to bring private resources to bear on the movement toward economical nuclear power.

Westinghouse Electric Corp. has been named development and design agent for the project, and Stone and Webster will build the plant.

Other new developments on the atomic scene:

· National Research Corp., Cambridge, Mass., has been awarded a contract by Atomic Power Development Associates to study the problems of remote fuel-element fabrication of the fast breeder power reactor. A high fraction of fissionable material in the fuel, together with relatively low burnup, are involved in this reactor. This short-cycle pyrometallurgical reprocessing of reactor fuel economically desirable. The high radioactivity of the fuel necessitates remote facilities throughout the process.

• Consolidated Edison Co. of New York has purchased 27,500 lb. of thorium from AEC for \$537,000 and applied to lease a sufficient amount of uranium-235 to enable work to proceed on its \$55-million atomic power plant expected to be in operation by 1960 at Indian Point, N. Y.

• AEC plans a gas-cooled power reactor experiment at the National Reactor Testing Station in Idaho. Proposals to participate in the experiment will be invited at an early date. To cost an estimated \$4 million over a period of several years, the experiment is intended to develop engineering data and experience for design and construction of military package power reactors and small civilian central station power plants.

Convention Calendar

- American Institute of Chemical Engineers, national meeting, including symposia on "Mixing" and "Unit Operations in Nuclear Engineering," William Penn Hotel, Pittsburgh, Sept. 9-12.
- New York University, second annual titanium lecture program, University Heights, New York, Sept. 10-14.
- American Assn. of Textile Chemists and Colorists, Perkin Centennial, Waldorf-Astoria Hotel, New York, Sept. 17-21.
- American Oil Chemists' Society, 30th fall meeting, Sherman Hotel, Chicago, Sept. 24-26.
- Atomic Industrial Forum, 1956
 Trade Fair of the Atomic Industry and annual fall meeting, Navy Pier and Morrison Hotel, Chicago, Ill., Sept. 24-28
- National Industrial Conference Board, Atomic Energy Course for Management, Biltmore Hotel, New York, Oct. 1-5.
- Technical Assn. of the Pulp and Paper Industry, 11th plasticspaper conference, Conway Hotel, Appleton, Wis., Oct. 3-4.
- Standards Engineers Society, fifth annual meeting, sessions on standards in the chemical industry and atomic energy field, Hotel Willard, Washington, Oct. 3-5.
- American Institute of Mining, Metallurgical, and Petroleum Engineers, annual fall meeting of metals division, symposia on nuclear metallurgy and titanium, Hotel Carter, Cleveland, Oct. 8-10.
- Society of the Plastics Industry, New England section conference, Wentworth Hotel, Portsmouth, N. H., Oct. 11-12.
- American Institute of Chemical Engineers, New York section annual all-day meeting, features symposium on cost estimation, Hotel Statler, New York, Oct. 18.
- Assn. of Consulting Chemists and Chemical Engineers, annual banquet and symposium, Hotel Belmont Plaza, New York, Oct. 23.

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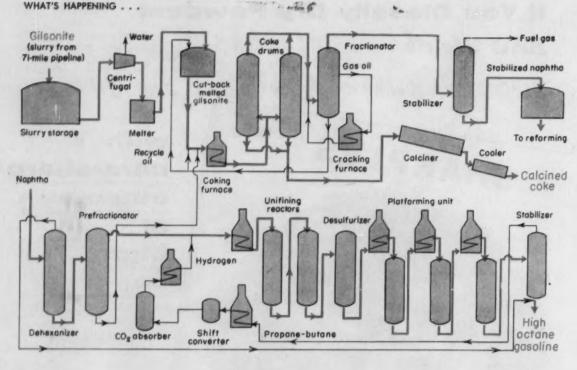
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Unique Gasoline Project Takes Shape

Gilsonite, a solid hydrocarbon mined in Utah, will yield high-octane gasoline and electrolytic-grade coke via delayed coking and two-stage reforming.

By this time next year American Gilsonite Co. should know whether or not its \$16-million gasoline-and-coke-from-gilsonite project in western Colorado and eastern Utah, now under construction, is a hit or a miss.

But there's nothing hit-ormiss about the way the firm-a joint affiliate of Barber Oil Corp. and Standard Oil Co. of Calif. -- is approaching the unique process and engineering problems involved in this pioneering venture, the world's first large-scale, privately financed project to produce conventional petroleum products from a solid raw material.

American Gilsonite's plans for converting gilsonite into high-octane gasoline and electrolytic-grade coke were out-

lined in broad strokes a year ago (Chem. Eng., July 1955, 104). President Ernest F. Goodner has, within the past few weeks, filled in the picture in enlightening detail.

► Cost Up 60%—Biggest difference between last year's story and this one is in capital investment. Originally estimated at \$10 million, investment is now expected to run about \$16 million. Estimated startup date has been moved back to next spring, rather than late this year.

Otherwise, the original bold concepts of the project remain essentially the same:

· At Bonanza, Utah, in the Uintah Basin, the company will mine gilsonite via newly developed hydraulic mining techniques.

· From the mine to the processing plant near Grand Junction, Colo., a distance of 71 miles, 600 tons/day of gilsonite will be pumped as a slurry in water through a 6-in. pipeline.

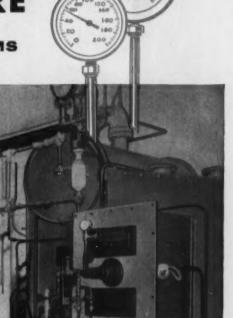
· Processing into coke and gasoline will involve delayed coking of gilsonite and recycle oil, fractionation of vapors from the coker, catalytic reforming of gasoline, thermal cracking of gas oil, thermal reforming of LPG to make reformer hydrogen and calcining the green

Gilsonite, Who and What-The raw material, gilsonite, is a black, solid hydrocarbon with a high resin content. Designated scientifically as "uintaite," its more common name is taken from an early pioneer in its commercial exploitation, Samuel H. Gilson.

For the past 70 years, gilsonite has been mined and marketed continuously. Among its uses: Battery cases, roofing felts, linoleum, floor tile, varnishes, phonograph records and HERE'S WHY YOU ARE AHEAD WITH FOSTER WHEELER

HIGH-TEMPERATURE LOW-PRESSURE

PROCESS HEATING SYSTEMS



This 1,200,000 btu/hr Dowtherm unit supplies precisely controlled process heating at 650F, 53 pai, for a fatty acid distillation plant at Compania BAO, Montevideo, Uruguay. Designed and engineered by Foster Wheeler, this plant has a rated capacity of 1500 lb per hr of crude fatty acid.

FW does the Complete Job

DESIGN INSTALLATION OPERATION SERVICE FW Dowtherm heating systems provide a vapor temperature range of 500F to 700F at vapor pressures of 15 psi to 95 psi absolute, fraction-of-a-degree temperature control, uniform temperatures throughout each processing step, fully automatic operation and low maintenance and repair costs.

Over 510 installations, in operation or on order, are proof of the acceptance and unique advantages of Foster Wheeler Dowtherm systems, for modern processing.

For complete information, send for your copy of 32-page Bulletin No. 1D-54-5. Foster Wheeler Corporation, 165 Broadway New York 6, N. Y.

FOSTER WHEELER

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PILOT PLANT at Bonanza, Utah, processed 100 tons/day of gilsonite.

thermal insulation. As principal producer, American Gilsonite estimates its current reserves at 16 million tons.

For a number of years, at a cost running over \$1 million, American Gilsonite has sought suitable means for processing gilsonite into products competitive with petroleum derivatives. This work reached its culmination two years ago when a single-drum delayed coking pilot plant, with a feed capacity of 100 tons/day, was operated at Bonanza.

Output of this pilot plant, and other extensive experiments, indicated that commercial manufacture could convert gilsonite into a high-purity coke, suitable for use as electrodes by the aluminum industry, and a high-octane gasoline with a ready market in the Colorado-Utah area.

► Wet Mining—Mining of the gilsonite ore will use two new "wet" methods developed by the company over the past four years.

In one technique, the gilsonite vein is shattered by a jet of water issuing from a 1-in. nozzle at a pressure of 2,000 psi. The other ore-cutting tool is a toothed, rotary drill which cuts a large swath through the ore while streams of water pour out through the teeth. This method is now in use. Both techniques eliminate the hazard of gilsonite dust.

▶ Pipeline Problems—The pipeline carrying the gilsonitewater slurry has posed some tough engineering problems. For example:

•What is the optimum solids concentration? A year ago the company mentioned a figure of 35%. Now it hedges a bit, unwilling to cite anything more specific than a range of 20 to 60%.

• What is the optimum velocity? Again, the company gives a wide range, 200-500 gpm. Significantly, the original plans specified an 8-in.-dia. line, instead of 6 in., indicating that either solids concentration or linear velocity, or both, will be higher than first anticipated.

· What happens if the line is shut down? There will be no low spots in the line between mine and refinery; the line rises at a steady slope over the high point near Baxter Pass, then drops at a steady slope to the refinery. The two pumps will have a spare one standing by; in event of power failure. the diesel-driven mining-water pump will serve the pipeline; finally, a water reservoir at the top of Baxter Pass will be used to flush the line if the flow should stop for some unforeseen reason.

▶ Pipeline Design—Feasibility of slurry pumping was demonstrated through use of a 5-mile line serving the pilot plant.

In addition, a pilot model was built at Golden, Colo., at the Colorado School of Mines Research Foundation. By including a radioactive section of pipe in the test line and measuring the radioactivity of the slurry in the effluent, it was possible to measure accurately the corrosion and wear in the line. By removing free oxygen from the slurry with sodium sulfite, corrosion was almost eliminated, the company says. Pipeline design, to be safe, allows for ½ in. corrosion.

Outside-packed plunger pumps will provide a pressure of 2,200 psi., consuming 570 hp.

Separation of the fine (minus in.) gilsonite from the water at the refinery posed another major problem. The way the company expects to handle this is to inject a small amount of oil into the pipeline upstream from its discharge point. Because of gilsonite's affinity for oil, the small particles will agglomerate in the oil phase, permitting separation from the water by "straightforward filtering or centrifuging operations."

▶ Processing Operations — Dewatered gilsonite will be heated to 450 F., well above its melting point, by mixing with hot recycle oil in the ratio of 2 parts oil to 1 part gilsonite. The cutback, melted gilsonite will be heated to 910 F. in a direct-fired horizontal heater, discharging into a conventional delayed coking unit.

Overhead from the coker will be fractionated, with the gasoline fraction going to a two-stage catalytic reformer, the noncondensable gases going into refinery fuel, and heavy bottoms recycling for gilsonite melting. A gas oil fraction is taken off and thermally cracked to gas, gasoline and recycle. All volatile hydrocarbons from the coker, therefore, end up as gas or gasoline.

Catalytic reforming will be novel in that there is a net hydrogen deficiency, rather than the usual hydrogen make. This is due to the high olefin and nitrogen contents of the coker gasoline. Makeup hydrogen is supplied by reforming with steam the propane and butane produced elsewhere in catalytic reforming.

In the first gasoline reforming stage (Unifining), the nitrogen is removed as ammonia. In the second stage (Platforming), the gasoline is upgraded in oc-



GOOD DRYER

> LED TO ANOTHER ... and ANOTHER ... AND ANOTHER

CHEMICAL COMPANY now has

STANDARD HERSEY

To tap the chemical resources of Searles Lake in California's Mojave Desert, it was necessary for the West End Chemical Company to set up a plant at the source of the raw product. Plant Equipment had to be rugged and dependable because repairs and replacement facilities were many long desert miles away.

Rotary dryers are vital to the West End process of manufacturing borates and soda products. Their first dryer in 1926 was a STANDARD-HERSEY and, with modifications, it is still in use. West End has since purchased 26 additional STANDARD-HERSEY rotary dryers-proof of STANDARD-HERSEY dependability.

Standard Steel Corporation manufactures more than 30 dryer types. Special equipment can be engineered to fill specific dryer requirements.

STANDARD STEEL CORPORATI



tane. Stagewise operation is necessary, since the nitrogen compounds would ruin the Platforming catalyst.

▶ End Products — Over-all yields, based on gilsonite charge to the refinery, are expected to be 50 weight % green coke, 35% gasoline (86 octane number without lead) and 15% 1,400 Btu. fuel gas. Initial output of coke will be 250 tons/day, with provision for expansion to 550.

Green coke will be calcined in a 10-ft.-dia. by 180-ft.-long rotary kiln to remove water, volatile and combustible materials. Calcined coke will be cooled in another rotating drum, 8 ft. dia. by 80 ft. long.

Inventa Process Gets First U. S. Try

First urea plant in the United States utilizing the Inventa process has been put on stream as part of Sohio's \$18-million petrochemicals installation at Lima, Ohio. Developed at the urea plant of Holzverzuckerungs, A.G., in Switzerland, it is licensed in this country and Canada by Vulcan Copper & Supply Co.

The process is reported to be outstanding for its low maintenance, high conversion per pass and relatively high product purity. A special (and undisclosed) alloy lining is said to solve corrosion problems and eliminate contamination with toxic metal salts. A gas-separation step skirts the touchy problem of recompressing recycle carbamate, with which other processes have to contend.

Liquid NH_a and CO_a react at 3,000 psi. and 360 to 390 F. The ammonium carbamate formed decomposes to urea and water at 80 psi. in the stripper, and unconverted NH_a and CO_a are removed from the urea solution. An aqueous urea nitrate solution selectively absorbs the ammonia, which is later removed, compressed and recycled.

British Prepare Atomic Pile For Startup

Pacifist atoms will swell Britain's electrical power supply next month, when Queen Elizabeth opens the first of two atomic piles at Calder Hall, Cumberland. Technicians, above, make preparations for inserting uranium rods. The full-scale plant will produce 92,000 kw. when completed early next year.

Two Firms Plan New Butadiene Capacity

Odessa Butadiene Co. and Humble Oil & Refining Co. have each started construction on new butadiene facilities at Texas plants. Odessa is building a 50,000-ton/yr. plant in Odessa, Tex., to be completed in mid-1957. Humble is increasing production from 49,000 tons to 65,000 tons at its Baytown, Tex., refinery. Expansion will center in feed preparation and butadiene recovery and purification sections.

New Entries, Treatments In Fibers Field

American Cyanamid plans a 27-million lb./yr. commercial plant to make its new Creslan acrylic synthetic textile fiber. To be located in northern Florida, completion is expected by mid-1958.

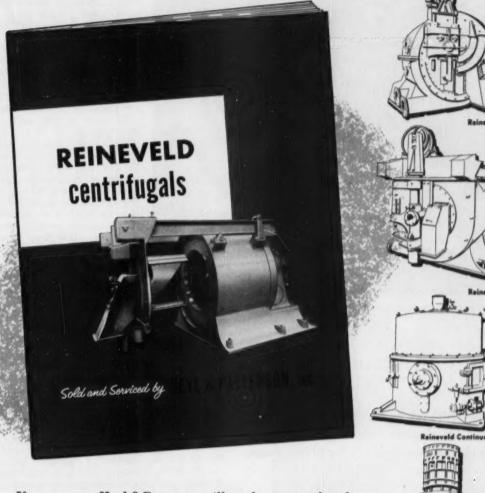
Other new acrylics include: Verel, to be produced soon by Tennessee Eastman; a Dow-developed product (production date unannounced), reported to be cheaper than some of those now on the market. Among the older acrylics: Du Pont's Orlon, Chemstrand's Acrilan, Carbide's dynel.

From three other sources come announcements of new fiber treatments. American Felt Co., Westerly, R. I., can now produce felt-like structures from any type of synthetic fiber via an improved technique for mechanically interlocking fibers. Product is suitable for high-temperature industrial use.

Tootal, Broadhurst, Lee & Co. of Great Britain have developed a treatment for linen which eliminates the need for ironing after washing.

U. S. Department of Agriculture has combined two effective flame-retardant treatments for cotton fabrics into a single treatment which is more effective than either alone. One of the processes utilizes tetrakis (hydroxymethyl) phosphonium chloride (THPC), and the other is an emulsion of bromoformtriallylphosphate polymer (BAP). USDA applies both simultaneously, 65% THPC resin and 35% BAP emulsion.

For the Engineer's File...



Upon request Heyl & Patterson will send you a new brochure illustrating and describing Reineveld Centrifugals. It is replete with tables and a wealth of design and operating data.

Something new has been added . . . interesting news about the *new Reineveld Continuous Centriplanes* . . . which have capacities from 3 to 10 tons per hour.

Write or phone today for H & P Brochure RC-356. It deserves a visible and reachable place in your technical file.





CHEMICAL ENGINEERING—September 1956

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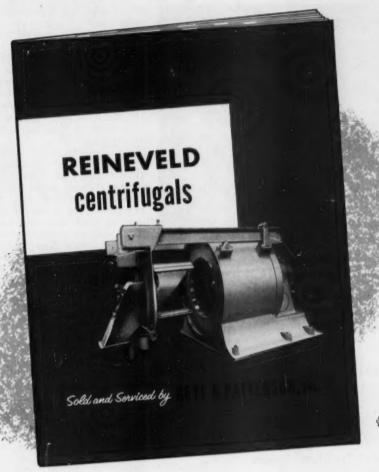
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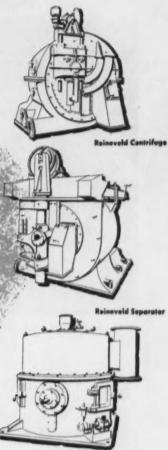
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Controlled dispersal of airborne effluents is usually the cheapest way. Wind-tunnel studies on small scale yield answers useful for plant design.

N EW YORK University's meteorological wind tunnel is one of the few places in the world where you can monkey with air pollution and do it with impunity.

Here an entire geographical area, its weather, climate and topography can be reproduced in miniature. Here the shapes and sizes of stacks and other structures and the character of an airborne effluent can be manipulated to come up with the least noxious combination. Here you reach the best compromise between those air-pollution factors which you can practicably control and those which you cannot.

► Tangible Results—For one of the most dramatic results of NYU's wind-tunnel work, consider Kaiser Aluminum and Chemical's new \$6-million fumecontrol system at its Chalmette, La., aluminum reduction plant. Nearing completion, the pollution-control system is topped off by a single colossal stack (500 ft. high, 45 ft. dia.) designed to shoot hot smoke and fumes to an altitude of 1,500 ft.

Fumes emanating from Kaiser's electrolytic cells formerly were dispersed through 128 squat 10-ft.-dia. stacks. When this practice produced an airpollution problem, Kaiser went to consultant groups for help. One of these, NYU's air-pollution division, studied, in the wind tunnel, an exact model of the Chalmette plant and surrounding territory.

Out of this study came recommendations for stack height and location, gas-ejection temperature and velocity that were later designed into today's aluminum plant. And the entire fume-control system—stack, ducts and scrubbers — was checked out in the tunnel before construction began.

▶ Pollution Palliative — NYU's wind tunnel offers a welcome palliative for industry's air-pollution distress. For, despite its somewhat bombastic publicity, air pollution remains, for the most part, a little-understood phenomenon.

Most techniques for controlling air pollution are based on keeping the pollutants out of the air. This is useful, perhaps mandatory, where the pollutants are intolerable or where valuable materials are reclaimable. It can also be pretty expensive. Into the Wild Blue Yonder-In many cases the expense is needless and/or unjustified. NYU's motto might be: Get the wastes into the air high enough and fast enough, and keep them there long enough, so that when they come down they won't bother anyone.

The open air, reasons NYU's engineers, with its diluting and purifying action, offers what is usually the most economical means of waste disposal. Let's see how we can best use it, they say.

▶ Enter the Wind Tunnel—The engineers decided early in the game that in order to study dispersal of gaseous pollutants they should be able to reproduce the pollution on a small, controllable scale.

The moving air stream of a wind tunnel seemed like a logical setting. Not an aeronautical tunnel which, it was felt, could not represent actual conditions, no matter how modified, but a special, low-speed job designed specifically for meteorological investigations.

The tunnel which the college researchers began in 1948 isn't really finished yet, although more than \$500,000 is already in it (Consolidated Edison and the AEC have been the most generous sponsors). It isn't finished because ways are still being found to increase its accuracy and versatility as a research tool.

▶ Realistic Answers — During these eight years of work the wind tunnel has yielded answers difficult or impossible to get by

INTALOX SADDLE PACKING

In the five years since Intalox saddle packing was first presented to chemical engineers as a uniquely new and different tower filling material, it has earned widespread acceptance.

Its better HTU values has permitted reduced tower heights resulting in savings in construction costs; its lower pressure drop has permitted savings in initial investment in blowers and pumps and substantial reduction in operating costs; its higher flooding limits have permitted higher liquid and gas rates.

This improved performance stems from the unique, patented shape of Intalox — a shape which makes possible maximum contact area between liquid and gas with minimum resistance to gas flow. A comparison of published data shows that size for size, Intalox offers: a greater number of pieces per cubic foot, a greater total surface area per cubic foot, a higher percentage of free space and less weight. Of even more importance than the greater physical surface area offered by Intalox is the fact that virtually all of the greater area is accessible surface area. For no two pieces of Intalox can "nest" to render ineffective any significant portion of the packing.



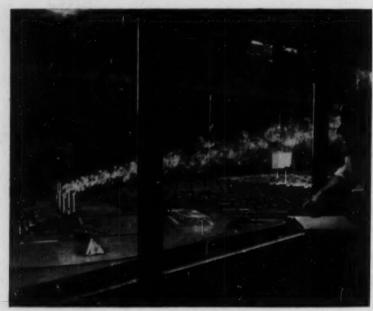
Intalox saddle packing is manufactured in white chemical porcelain and in chemical staneware. It is made in six nominal sizes: 14", 14", 14", 1", 114" and 2". Full technical data is given in Bulletin 5-29, free on request.



U. S. STONEWARE

AKRON 9, OHIO





Scale model tested in wind tunnel shows how . . .

You Can Avoid Air Pollution

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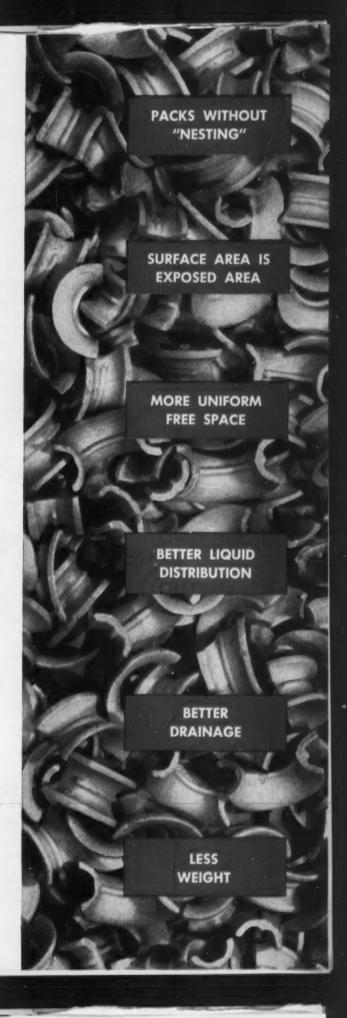
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analytical means. These answers have modified the conclusions formerly reached through empirical relationships. For example, the rule of thumb that says a stack should be 2½ times as high as an adjacent building may lead to unnecessarily high and costly structures.

This doesn't mean that empirical and analytical methods should be pigeon-holed. On the contrary, the wind tunnel affords the engineer a chance to prove out these rules before committing himself to construc-

tion.

▶ Basic Procedure — Beauty of the wind-tunnel research is that it can anticipate, it can relieve, and it can prevent air-pollution headaches. Let's suppose, for

example:

· You are planning a new plant or an expansion of an existing one. NYU's air-pollution research group will build an architect's model of the new facilities and their environment in the wind tunnel and watch the behavior of smoke plumes. If the model doesn't meet air pollution standards, changessmoke densities and discharge rates, heights and arrangements of buildings-can be made then and there. And then and there you save the money which you would have had to lay out for pollution control according to the original construction plan.

• You have your plant in operation and your neighbors and employees are unhappy about the disposal of your airborne wastes. Now the wind tunnel can point to alterations which will make better use of all that air above the plant, will show you how to get the smoke higher. Maybe a stack nozzle to step up gas ejection velocity, or a higher ejection temperature, or better correlation of the discharge timetable with the most favorable local weather conditions is the most econom-

ical answer now.

Start Early—But whether the engineer comes to NYU or to another research group for airpollution counsel, a good rule to observe is: Start early.

Air-pollution control should not be a modification of an existing design but an integral part of design. It's far better to relocate stacks and buildings on paper before processes are fixed, says Dr. Gordon Strom, who heads up NYU's air-pollution group.

Trick or Treat—Much of the philosophy of the wind tunnel group is a reflection of a growing industrial awareness that meteorological conditions pose both a trap and a salvation for the plant designer and operator as they seek to minimize air

pollution.

When a site for a new plant is being considered, industry is cautioned to be on the lookout for a geographical area which has, in addition to other requirements, a climate favorable for atmospheric diffusion of gaseous wastes. When the general area is set, local weather features of various sites within the area should be checked on. When the site is fixed, begin to measure existing pollution and meteorology before construction starts. In this way you can anticipate what your new plant will contribute to local over-all air pollution.

If you decide to take your problem to NYU's wind tunnel, researchers there will want such things as these: Dimensions of the plant (existing or planned), gas properties, description of the surrounding region, local meteorology and sensitivity of the area to pollution (record of complaints and their relation to the meteor-

ological data).

And Strom and his group like to have a company representative at the wind tunnel so recommendations can be the sort that can be reasonably carried out by the particular client.

Measured against possible benefits, research cost to the client for a survey is modest: \$5,000-10,000 for labor plus overhead.

News Briefs

Petrochemicals: Warren Petroleum Corp. plans to build a \$5-million petrochemicals plant near Houston.

Carbon black: Continental Carbon Co. has just started up a 25-million lb./yr. plant for furnace-type carbon black in Eunice, N. M.

Aniline: Second unit of National Aniline Div.'s Moundsville, W. Va., aniline plant is now operating, doubling initial capacity. Like the first unit, on stream last spring, it uses a new, company-developed catalytic process.

Bromine: Great Lakes Oil & Chemical Co., Los Angeles, has begun construction of a major addition to its Filer City, Mich., bromine plant, expected to double plant production. Cost: About \$350,000.

Oxygen: Liquid Carbonic Corp.
plans completion of a \$4-million liquid oxygen plant in
the San Francisco Bay area
by the end of the year. It's
just completed a \$1-million
electrolytic hydrogen plant in
San Carlos, Calif.

Oil shale: Navy has assumed custody of and will continue to operate the government's oil shale facilities at Rifle, Colo. Transfer from the Interior Dept.'s Bureau of Mines was necessitated when Congress failed to appropriate money for continuation of oil shale work.

Butyl rubber: Thiokol Chemical Corp., Trenton, is entering the butyl rubber field in cooperation with Petroleum Chemicals, Inc., a licensee under Esso Research and Engineering Co. for the manufacture of butyl. Thiokol will handle sales and applications research.

Sodium borohydride: Metal Hydrides has received a \$13.6-million government contract to supply tonnage quantities of sodium borohydride.

Solar energy: A 30- to 50-ft.-dia. solar furnace, to cost \$250,-000, will be built in central Arizona within a year, according to the Assn. for Applied Solar Energy at Phoenix. Funds will come from about 20 Arizona individuals and business firms.

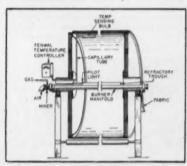
Controlling A Radiant-Heat Drying Drum

No. 3 in a series

Showing the Broad Application Range of Fenwal Controls

This high-temperature, radiantheated drying drum is used for drying printed fabrics or for heat-setting synthetic coatings onto fabrics. Particularly interesting is the way in which it combines a Fenwal unit and quick cooling features to secure the close temperature control necessary to prevent scorching the fabric in case of shut-downs.

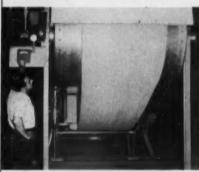
The drum is usually operated at a surface temperature of 350° to 450° P, but can maintain temperatures up to 700° F, as required. The revolving drum surface is heated by a combination of infra-red rays and convection from a refractory trough heated to incandescence (about 2400° F) by a gasair manifold burner.



Drum temperature is controlled by a Fenwal Series 540 Indicating Temperature Controller. As shown in the diagram, this is connected by a capillary tube to the temperature-sensing bulb, located close to the interior surface of the drum. The trough and manifold are stationary along the axis of the drum. Flame is played along the surface of the trough by a series of jet nozzles, burning a mixture of air and natural or manufactured gas. To aid in preventing scorching the product, materials used for the drum and heater system are of lowest practical heat capacity. The drum surface is of 16-gauge steel, which assures a low heat content.

Also, the combustion air supply doubles as a coolant for the drum. The air stream is not tied in with the temperature control system and continues to flow after the gas is shut off. Thus, it quickly cools the heater

trough and blows the heated air out of the drum. This, plus the low heat capacity of the drum surface, provides the required safeguard against scorching the product during sudden shut-downs.



PRECISE TEMPERATURE CONTROL, provided by a Fenwal Series 540 Temperature Indicating Controller (shown at left) is one of the advantages enabling this huge drying drum to set new records for efficiency. In one installation, three 60° diameter drums of this type are drying the same yardage as 20 previously used steam-dryers.



Control Within 14 of 1%

When the operator sets this Fenwal Series 540 Controller to the required processing temperature, he knows that temperature will be maintained—on the button! Heat input is controlled by the Fenwal unit, actuating a solenoid valve in the supply line. The gas, maintained at atmospheric pressure by a diaphragm regulator, is drawn into a proportioning mixer valve under negative pressure created by the air stream. The air supply, maintained at approximately one psi, reaches the mixer through a separate supply line.

With the Series 540 Control on guard over the heating system, the manufac-

turer of this advanced drying equipment states that the temperature of the drum surface is maintained within ± one-quarter per cent of the controller scale — outstanding performance for processing equipment of this type.

A Versatile Instrument



The Series 540 Controller is fully adjustable between 100°F and 700°F. Temperature differential is adjustable between 1% and 4% of scale temperature ranges by internal adjustment of pilot contacts. Uniform sensitivity and close accuracy throughout its range are characteristic, making it an ideal temperature indicating controller for kilns, ovens, liquid baths, baking ovens, packaging machinery and general industrial processing.

For Your Own Applications

Investigate the many different types of Fenwal temperature control and detection devices. Besides the Series 540 described here, these include standard THERMOSWITCH[®] units, Midgets, Miniatures, etc. Send the coupon for new Catalog No. 500. Remember that Fenwal's engineering staff is always ready to help you solve any temperature control problem.

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CONTROLS TEMPERATURES . . . PRECISELY

Life on the Chemical Newsfront



NEW ANILINE DERIVATIVE AIDS GLAUCOMA SUFFERERS. A common cause of blindness, glaucoma is a condition in which fluids accumulate within the eye, eventually damaging the optic nerve. Diamox* Acetazolamide, available only on a doctor's prescription, can be taken orally to reduce the watery secretion entering the eye and usually affords quick relief. Used in conjunction with other drugs, Diamox may provide adequate therapy, and in severe cases considerably increases the possibility of corrective surgery. Diamox is one of the latest in a long line of pharmaceuticals derived from Perkin's experimentation with aniline. (Lederle Laboratories Division)



Fifty years ago, as recipient of the first Perkin Medal, William Henry Perkin told his American colleagues, "... that this industry which I was permitted to found should have led to this result is a source of pleasure to me because the final result of our work should be the benefit of mankind."

THE PERKIN CENTENNIAL 1856-1956

This month, the chemical industry commemorates the 100th anniversary of the discovery of the first synthetic organic dye by William Henry Perkin. The stature of today's chemical industry reflects the importance of Perkin's work. For not only was a new dye industry born that day in 1856, but also the branch of the chemical industry based on synthetic organic chemicals.

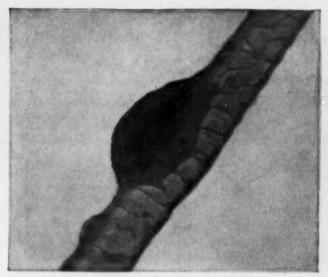
Until 1856, chemical science had been content to synthesize naturally occurring materials. After that date, the objective became the synthesis of products that improved on nature. The results are evident in the dyes, drugs, solvents, plastics, fibers, insecticides and fuels which so profoundly affect our lives today.

Cyanamid owes much to Perkin's early work. Many of our products to-day would be familiar to him. Others are derived through methods far beyond the limits of his day, yet are outgrowths of the work he initiated. Each product described on these pages is related to the coal-tar chemistry to which Perkin devoted his life.



HELPING COLOR STAND UP TO SUN-LIGHT has long been a major objective of chemistry. New protection new can be

chemistry. New protection now can be secured with Cyanamid's UV Absorber 9. Related to dyes which selectively absorb some wave lengths of light and reflect others, UV-9 absorbs strongly in the ultraviolet portion of the spectrum, thereby converting the color degrading rays into harmless heat. Colorless itself and highly stable, UV-9 is compatible with a wide range of formulation possibilities to protect clear or colored materials against discoloration, fading and deterioration in sunlight. Use in transparent films, waxes and surface coatings over light-sensitive materials is particularly recommended. (New Product Development Department 8)



SEEN FOR THE FIRST TIME in dyeing history is the actual mechanism of fiber dyeing through the use of the Microdyeoscope, a development of Cyanamid's Organic Chemicals Division. A significant step in dye research, this instrument permits continuous microscopic observation of individual fibers through the complete cycle of dye-bath operation. Not only has the Microdyeoscope shed light on details of traditional dye techniques, but it is proving valuable in developing new dyes and dyeing processes for new fibers and fiber mixtures. Through such developments, one of the oldest of the commercial "arts" is fast becoming a well-understood science. (Organic Chemicals Division)



NEW COLOR STYLING EACH SEASON has been made more practical through steady reduction in dye costs. In 1856, Perkin's first commercial dye was worth its weight in platinum! An initial step in overcoming high raw material costs was the synthesis of anthraquinone from phthalic anhydride. Next, phthalic anhydride was produced by catalytic oxidation of naphthalene, and dye prices tumbled rapidly, making color available for every purpose. With bulk use growing, further savings in cost in many fields are made possible by the availability of Cyanamid phthalic anhydride in molten form, (industriel Chemicals Div., Dept. B)



SPIC AND SPAN NOW—but there's a look in the eye that says it won't last! Even so, children's clothes today can stay colorful longer despite repeated soiling and washing. Of the many dyes developed since Perkin's time, none surpass the vats in colorfastness. Because of this property, they are superior for draperies, play clothes, slip covers, work clothes, bathing suits, shirts and many other fabrics made from cotton, viscose rayon and linen. The U.S. Army specifies vat-dyed fabrics for every possible use in government issue clothing. These goods can be expected to take rugged wear, heavy soiling, hard rubbing, frequent washings and still stay colorful when they are vat dyed. (Organic Chemicals Division)



COLOR INVADES THE KITCHEN, making mealtime chores more pleasant in lively and attractive surroundings. The modern trend in home decoration has created a demand for bright pastels and decorator colors in major appliances. Today, refrigerators, stoves and sinks, traditionally white, are available in many hues. Cyanamid pigments are contributing to this more pleasant way of life by providing test-proved color durability in architectural, household and appliance finishes, plastics, floor coverings and other materials found in today's modern kitchen. (Pigments Division)

Additional information may be obtained by writing on your letterhead to the Division of American Cyanamid Company indicated in the captions.

Building for the Future Through Chemistry



Chemicals & Raw Materials

EDITED BY R. K. GITLIN



35% HYDRAZINE SOLUTION added to boiler sytems . . .

Scavenges O2 in Feedwater

Stable, nonflammable form of hydrazine promises to extend hydrazine's hitherto limited use as a deoxygenator in boiler feedwater treatment.

Despite its many advantages in boiler feedwater treatment, hydrazine has found limited application in this field because of the handling precautions necessitated by its flammability.

But now, a new, nonflammable form promises to eliminate these restrictions and to extend its use in both high- and lowpressure boilers.

Called Scav-Ox, the new form is a 35% aqueous hydrazine solu-

tion which has neither flash nor fire point, yet retains all of hydrazine's advantages over traditional sodium sulfite as an oxygen scavenger and corrision inhibitor:

• Higher oxygen removal ef-

 Adds no dissolved solids either in original form or through reaction products—to the water.

· Improves heat transfer.

• Effects savings in material

Less Needed for Higher Efficiency—Hydrazine's oxygen removal efficiency is much higher than sodium sulfite, which means that less treating material is required to get the same results.

For example, one pound of hydrazine will remove as much oxygen as eight pounds of sodium sulfite on a theoretical basis. But in actual practice, it's customary to maintain a high residual of sodium sulfite in the boiler water. Therefore, in many cases, hydrazine can replace as much as 50 times its weight of sulfite.

In terms of a typical industrial operation, let's look at Olin Mathieson's steam plant at Brandenburg, Ky. Treating 4.6 million lb. of feedwater daily, this plant uses 76 lb. of hydrazine—or 25.4 gallons of Scav-Ox—a year. The same job previously done with sulfite required handling and storing of 3,650 lb. of the solid chemical a

Improves Boiler Efficiency—Hydrazine's second big advantage over sodium sulfite is that it doesn't put solids into the water. Sulfite adds dissolved solids, either as the original sulfite or as sodium sulfate after reaction with oxygen. These hard-to-remove solids build up a coating on the boiler tubes and drum surfaces, reducing boiler efficiency.

Hydrazine, on the other hand, is a clear, water-white liquid whose only reaction products with oxygen are nitrogen and water-meither of which is detrimental to the boiler or its operation.

Through its partial breakdown to ammonia, hydrazine, further contributes desired alkalinity to boiler feedwater. And it also improves heat transfer by reducing ferric oxide scale in the boiler to magnetic iron oxide.

► How and Where it's Used— As Scav-Ox, hydrazine can readily be fed continuously to industrial boilers—both highand low-pressure types—safely and conveniently via a chem-

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CHEMICAL ENGINEERING—September 1956

Hydrazine solution scavenges O146A
Chromium plating additive148A
Synthetic ambergris148B
Manganese-bismuth magnetic powder150A
Anionic surfactant150B
Synthetic mica in sheets
Two familiar plastics in new form152A
Silicone tire release agent152B

Soil fumigant gets horticulturists' OK1520
New price schedule for Kel-F elastomer154A
Trially citrate
Thickening agent for latex paints1540
Biologically stable casein
New thickener for jellying gasoline154E
Delayed-action rubber accelerator154F
Multi-functional alkanolamine154G
Adipic acid at reduced price154H

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ical proportioning pump leading into the feedwater line. (The solution is usually introduced at a point between the outlet of the deaerator and the intake of the boiler feedwater storage tank.)

Theoretically, one pound of hydrazine is needed to remove one pound of dissolved oxygen. This relationship is used as a basis for calculating the amount of Scav-Ox to be added to the boiler feedwater for complete oxygen removal. Sometimes, however, after a hydrazine residual has been established, there's a tendency for hydrazine to build up in the system so that the initial feed rate can be reduced without losing the protection of a residual in the boiler.

Several types of equipment (e. g., color comparator, precision instruments) have recently been made available for determining hydrazine residual. ▶ Effectiveness Compensates for Cost-Although the cost of Scav-Ox per pound is higher than that of other water treating chemicals, its extreme effectiveness usually results in decreased treating cost. For example, chemical cost of treatment of boilers in one Olin Mathieson plant was cut almost 50% by switching from sodium sulfite to hydrazine.

And even greater savings can result from decreased maintenance, less corrosion, increased heat transfer efficiency, etc.

► Other Uses Foreseen - Because of the great number of industrial situations involving exposure of metals to dissolved oxygen, only a small fraction of the possible uses of hydrazine for corrosion inhibition have been evaluated or even suggested.

Aside from the boiler feedwater field, some applications showing promise include laying up idle boilers in wet storage, laying up idle storage tanks and process equipment, hot water space heating system, hydraulic testing of process equipment, water circulating systems in nuclear reactors.-Olin Mathieson Chemical Corp., New York 22, N. Y.

Cr Plating Additive

Simplifies, speeds up chromium plating operations.

A new catalyst "representing America's first commercially successful chromium plating additive developed by a basic chromic acid producer" is being touted by Diamond Alkali as both a cost-saving and qualityimproving material for decorative and chrome plating applications.

In replacing part of the sul-

fate used in conventional chrome-plating solutions, Diamond's new CPA 1800 is said to speed up and simplify plating operations by providing:

• Faster plating - Through increased cathode current efficiency and use of higher current densities.

· Broader operating range of plating solution.

· Greater covering power-Simplifies plating of complex shapes with intricate recesses.

CPA 1800 also makes possible the electrodeposition of brighter and harder chrome coatings, simplifies anoding in hardchrome applications, improves metallurgical characteristics of chromium plate. - Chromium Chemicals Div., Diamond Alkali Co., Cleveland, Ohio. 148A

Synthetic Ambergris

Stronger, cheaper than natural odor.

Now that Dragoco (Holzminden, Germany) has succeeded in producing a cheap, synthetic ambergris, perfumers will be in a position to make wider use of the hitherto extremely expensive odor.

Called Ambropur, Dragoco's synthetic is a thick yellowish oil which duplicates the scent of ambergris in all respects but one-its strength, and consequently its effect, is far superior to the natural odor.

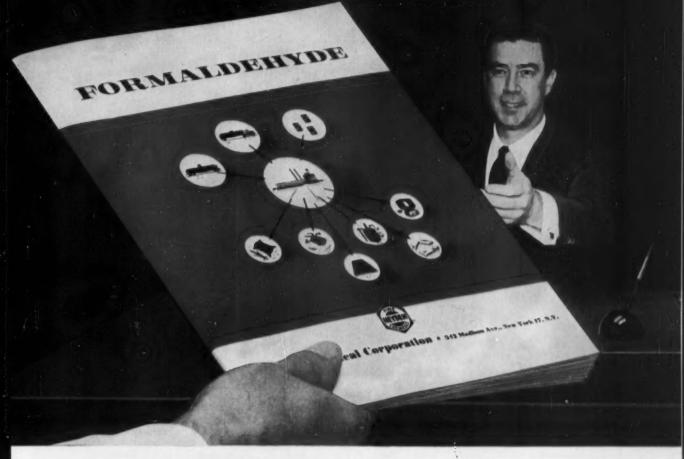
One drop of 0.1% alcoholic solution of Ambropur on a blotter persists almost completely after 5 days despite strong dilu-





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New!--- from Heyden



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FORMALDEHYDE

This informative Heyden Booklet—just off the press and ready for the process industries—contains technical information on formaldehyde which will be of value to you in your production and development work. It answers questions on physical properties, specifications, typical reactions and construction materials for storage and handling. It gives detailed facts on industrial applications in the fields of agriculture, plastics, pharmaceuticals, dyes and textiles, metals, paper, rubber, petroleum, leather, explosives.

The new Formaldehyde booklet contains: Product Data.. Methods of Analysis.. Safe Handling.. Materials of Construction.. Storage and Shipping Data.. Industrial Applications.

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Benzaldehyde - Benzoic Acids - Benzyl Chloride - Beta-Oxynaphthoic Acid - Chlorotoluenes - Creosotes - Fermaldehyde - Formic Acid - Guaiacots Parahydroxybenzoates - Pentaerythritols - Propyl Gallate - Resorcinol - Salicylates - Salicylates - Sodium Benzoate - Sodium Formate tion while a drop of 5% ambergris tincture disappears entirely in the same period.

Aside from Ambropur, Dra-

goco has introduced two other products which are also related to genuine ambergris—Ambrofix and Ambron. Ambrofix is a

fixative possessing the special fixing qualities of amber musk character. Ambron is a modifying agent with excellent adhesion qualities.

All three synthetics are used in compounding or in finished perfumes.—Dragoco, New York, N. Y. 148B



Magnetic Powder Produces Fiery Waterfall

What you see above isn't a belated July 4 celebration, but a demonstration of the spontaneous ignition—in air—of a new manganese-bismuth powder destined to yield more powerful permanent magnets.

The new magnetic material, a chemical compound having the formula MnBi, is reported to have 10 times the resistance to demagnetization of most of its commercial rivals. This resistance, coming from a magnetic property called high coercive force, prevents MnBi magnets from being adversely affected by external magnetic fields, suggests their use in electric meters where stray magnetism from large electrical equipment is likely to be encountered. And it also make possible a whole assortment of permanent magnets having novel shapes, e.g., thin wafers and disks.

Although manganese-bismuth magnets have been predicted for several years, this is the first time they have been produced in a pure enough form to realize their potential abilities.

To get the super-pure product, manganese and bismuth are ground together under an inert atmosphere of helium gas-to prevent spontaneous combustion of the mixture (see above). Next, the mixture is sealed in a glass vessel under low-pressure helium and heated to just under 520 F., bismuth's melting point. The resulting powder, virtually 100% pure MnBi, is then reground to a fine powder (each particle about 1 micron in diameter), imbedded in a plastic matrix, oriented in a powerful magnetic field and molded to shape to form a permanent magnet.-Westinghouse Electric Corp., Pittsburgh 30, Pa. 150A

Anionie Surfactant

Has high solubility, stability in strong electrolyte solutions.

A new sulfonate-type surfactant, possessing unusually high solubility, stability and surface activity in strong electrolyte solutions is Dowfax 2A1.

This anionic surfactant, a light-colored, free-flowing powder, is effective in a number of industrial fields including:

- Metal cleaning—As a wetting agent in plating and electrolytic cleaning.
- Detergents Household and industrial cleaners.
- Petroleum—As a wetting agent for water flooding operations.
- Paper—Decreases pulping cycle in sulfite, sulfate, semichemical processes.

2A1 is especially effective in aqueous solutions of acids, alkalis and salts. It's a moderate sudsing agent, susceptible both to foam boosting and defoaming action.—Technical Service and Development, Dow Chemical Co., Midland, Mich.

150B

Synthetie Miea

Available in powder and sheet form.

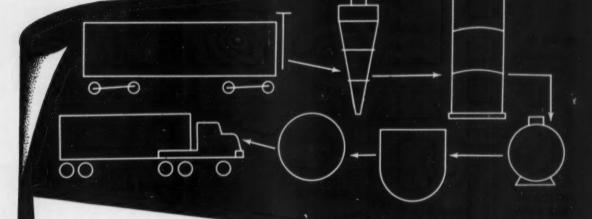
Four forms of Synthamica, a chemically pure synthetic mica capable of withstanding sustained temperatures to 2,000 F. without physical or electrical failure, are now available for a variety of industrial applications.

- Synthamica 202 Highquality, synthetic mica in flake or powder form. Can be ground to any commercial mesh.
- Synthamica 707 Fully cured, rigid, bonded, inorganic punching material. Available in

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Also included in the Sprout-Waldron line are gyro shakers, stream splitters, dust

collectors, reels, shaking and gyrating screens, and air separators.

With each Sprout-Waldron machine, you receive a **BIG PLUS** at no extra cost. This provides you with expert, unbiased engineering counsel and guid-

cost. This provides you with expert, unbiased engineering counsel and guidance on installations and applications . . . plus an ability to "adaptioneer" equipment to meet your individual requirements . . . plus 100% reliability. Sprout-Waldron's BIG PLUS can save you money on first costs and reduce your operating expenses.

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thicknesses from .005 to .100 in. • Synthamica 727 - Flex-

ible, partially cured, inorganic bonded material. May be formed into three-dimensional shapes or wrapped around conductors for insulation. Heat curing produces rigid body with good dielectric properties.

• Synthamica 807 - Inte-

grated synthetic mica paper sheet containing no chemical binder. Has little mechanical strength, but is of interest for applications requiring pure mica paper. Chemical hardening treatment may be applied as required. - Synthetic Mica Corp., Caldwell Township, N. J.

	Linear P	Capolymer	
	Ziegler	Phillips	Styrene
Specific gravity	0.945	0.96	1.01
Water absorption (24 hr.)—%	0.1	0.0	0.28
Heat distortion (66 psi.)—F		168	183
Tensile strength—psl		5,100	4,500
Elongation—%	300		100
Modulus of elasticity—psi. x 105	0.64-1.0		1.96
Flexural strength—psi			6,800
Notched Izod impact strength-ItIb	2.5-5.0	3.0	1.6 at -40 F.
Rockwell hardness -"R" scale	32-43		85

Linear Poly, Copolymer Styrenein New Form

Extruded sheets of these two familiar plastics feature high impact strength.

Two familiar synthetics, lowpressure polyethylene and copolymer styrene, have hit the market in new forms-extruded sheets.

· Extruded linear poly, previously available in calendered film, has excellent resistance to heat distortion, improved rigidity and impact resistance, even in thin gages.

Since it's new on the market, not many applications presently exist. But prominent uses will most probably be in packaging of both industrial and consumer goods. Readily vacuum-formed, extruded poly sheets should find applications in such items as containers, acid carboys, etc.

Heavy-duty sheets can be vacuum formed into complex shapes and deep draws. However, some slight modification in present heating equipment may be necessary to accomodate the material's different heating and cooling cycles and tendency toward plastic "memory."

· Extruded copolymer styrene sheet, labelled Campco S-1029, is available in thicknesses to & in., boasts improved strength and color control over conventional thick sections. (Ordinarily, thick sections are produced by laminating, with resultant loss in both strength and color control.)

S-1029 has outstanding impact strength, even at temperatures as low as -40 F. It also has high tensile and flexural strength, relatively high heat distortion point.

Biggest markets are expected to be in applications like machine housings; luggage; automotive panels, liners, seat skirts.

Since extruded sheet is free from internal strain and high in strength, S-1029 can be readily vacuum formed into complex shapes. Using proper techniques, unusually draws can be formed.-Campco Div., Chicago Molded Products Corp., Chicago 35, Ill.

Tire Release Agent

Organo-silicone solves surface problem facing tire manufacturers.

manufacturers, constantly faced with the surface problem of lubricating and releasing the butyl rubber bag used inside a tire to force it into the mold, should welcome a new organo-silicone tire release agent, L-522.

This water-insoluble compound is a low-viscosity, light yellow liquid which lubricates the rubber bag—allowing it to slide in neatly and release

Formulations containing L-522 have been widely used both inside and outside the green tire-in both Bag-O-Matic and conventional machines. Inside formulations are designed for good lubricity and release between rubber bag and tire. Outside paints increase release properties, minimize rundown after application, prevent slippage crease, eliminate trapped gases.

In addition to its lubricatingrelease properties, L-522 is compatible with the "balancing dough" used to add weight to any tire part to make the tire properly balanced. And unlike conventional silicones, it doesn't prevent adhesion of the rubber label placed on every tire.

Increased production of L-522 has made for manufacturing economies which are being passed on to the consumer. Price of 55-gal. (440 lb.) drum has been lowered from \$3.05 to \$2.80. - Silicones Div., Union Carbide and Carbon Corp., New York 17, N. Y.

Soil Fumigant

Pest killer, touted by horticulturists, now offered by new source.

Good news for farmers, gardeners, nurserymen on two counts. Vapam, the soil fumigant introduced last year by Stauffer Chemical Co. (1) has been given an unqualified OK by plant scientists at Louisiana State University for use in controlling weeds, diseases, grasses and nematodes and (2) is now



Will These Properties of Snowflake Crystals Improve Your Product?

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Para-dichlorobenzene • Ortho-dichlorobenzene • Hydrogen Peroxide

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available from a new source, Du Pont.

In a report recently issued by LSU's plant pathology department, farmers were told that they can't afford not to use Vapam. Like methyl bromide when combined with seed treatment, the new chemical (sodium methyl dithiocarbamate) gives excellent control of damping-off of young plants in hotbeds. And it also keeps down grasses and weeds in hotbeds, eliminates nematodes.

The report also points out that Vapam, contrasted with other soil fumigants, is easily applied. All that's needed is a sprinkling-can application of the chemical solution. Soil in hotbeds, lawns or flower beds is then soaked with plain water to drive the fumigant down deep into the soil. "It's as simple as a shotgun to use, but as effective as an atomic weapon."

Since Du Pont has been licensed by Stauffer to produce Vapam, there are now two sources of the new soil fumigant.—Stauffer Chemical Co., New York 17, N. Y.; E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del. 152C

BRIEFS-

Kel-F elastomer, a nonflammable rubber with high resistance to solvents, fuels, lubricants and other chemicals, has a new price schedule for two commercial grades. The schedule starts with a base price of \$15/lb. and is on a sliding scale depending on quantity ordered: \$16 in 1-99 lb. lots, \$15.50 for 100-1,990 lb., \$15 for orders of 2,000 or more lb. (Elastomer was previously priced at introductory \$25/lb.).—M. W. Kellogg Co., New York, N. Y.

Triallyl citrate has been made available to industrial researchers in 4-oz. samples. A citric acid derivative, the citrate is considered to be particularly useful in the plastics industry as a crosslinking agent for polyester resins. This highly unsatu-

rated, reactive monomer can be polymerized to hard, brittle thermoset polymers. It's immiscible with water, miscible with acetone, benzene, chloroform, dioxane, ethanol and glacial acetic acid.— Chemical Sales Div., Chas. Pfizer & Co., Inc., Brooklyn 6, N. Y. 154B

High viscosity thickening agent, Cellosize hydroxyethyl cellulose WP-4400, offers a number of performance advantages in latex paints: Excellent scrub resistance; rapid paint processing and pinhole prevention (both due to low foaming excellent characteristics): pigment dispersion; brushability, flow out, leveling; enhanced mechanical, freeze-thaw and viscosity stability. WP-4400 goes into solution at room temperatures; solutions don't gel up to 212 F.-Carbide & Carbon Chemicals Co., New York 17, N. Y. 154C

Biologically stable casein, containing a built-in preservative which can't be leached out of the product or extracted by an emulsified oil phase, resists microbial spoilage and insect infestation. It should therefore allow manufacturers to use casein as a binder or dispersing agent for pigments without having to consider spoilage problems. Product, being produced in pilot plant quantities, has excellent storage properties, mixes easily with water, has excellent viscosity in solution.—Chemical Div., Borden Co., New York 17, N. Y. 154D

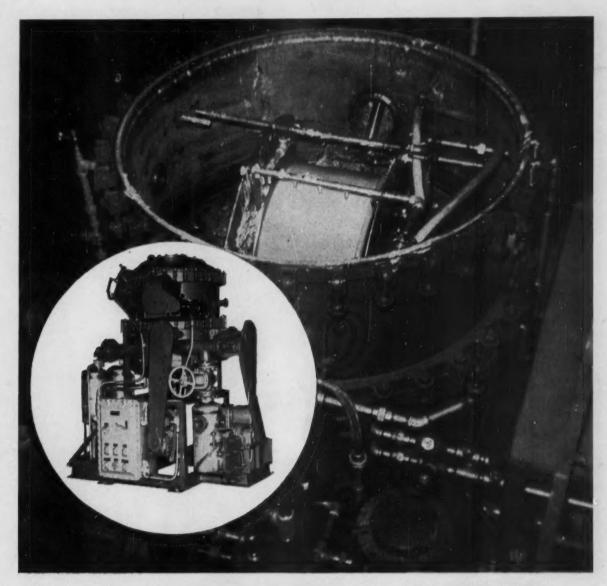
An aluminum soap of isooctanoic acid has been developed as a thickener for jellying gasoline-source of flame for fire bombs, flame throwers and other flame weapons. Developed by the Army Chemical Corps in conjunction with industry, the new soap is derived from an aluminum compound and a domestic petroleum product. It's designed to replace conventional gasoline thickeners usually made from an aluminum compound plus three

other ingredients—oleic acid, naphthenic acid and imported coconut fats. At present, two companies have contracts with the Chemical Corps for the soap's production.—Nuodex Products Co., Inc., Newark, N. J.; Wites Chemical Co., New York, N. Y. 154E

Delayed-action rubber accelerator. Dibs Accelerator, meets the high processing temperatures built up during mixing and extruding of super abrasion furnace black stocks. The new compound (N. Ndiisopropyl benzothiazole-2sulfenamide) has a melting range of 131-139 F., permitting easy incorporation in furnace black stocks. And it has good storage stability under normal temperature conditions. Dibs should prove of special interest to tire manufacturers and others who are up against severe scorching problems in processing. Rubber Chemicals Dept.. American Cyanamid Co., New York 20, N. Y. 154F

Multi-functional alkanolamine, monohydroxyethyltrihydroxypropylethylenediamine, is now available to research and production chemists for use as an intermediate in syntheses of insecticides, plasticizers, surfactants, etc. In addition to six reactive centers, this new water-soluble compound possesses basicity, solubility, volatility and other properties comparable to aminohydroxy compounds of similar structure. Presence of both primary and secondary hydroxy groups creates considerable reaction selectivity.-Visco Products Co., Inc., Houston 5, Texas. 154G

Adipic acid's price has been reduced from 35-32\$/lb. (carload, truckload) as part of a long-range plan to provide economic encouragement to expanded uses—e.g., in manufacture of plasticizers and polyesters for polyurethane foams, reinforced plastics, wire coating enamels, solid propulsion-type fuels.—E. I. du Pont de Nemours & Co., Wilmington 98, Del. 154H



WE CAN'T SEND A SAMPLE

Eimco's Research and Development Center has the answer for the plants with difficult filtration problems. The engineers at the Center know that under certain product conditions it is unwise for the laboratory to try to reproduce plant conditions in which the sample was taken.

The alternate is to provide test equipment at job site suitable for wide range filtration problems. Eimco has designed several units similar to the unit shown above that can be used as standard drums, precoating drums, pressure drums and pressure precoating drums. These units are also equipped for washing and can use several types of cake removal attachments.

Eimco's experience in over half a century of service to process industries has given them the advantage of understanding filtration problems. The need for developing and producing numerous types of filtration equipment gives Eimco more opportunity to serve the customer's needs.

Eimco's objectives are: 1. To solve the customer's filtration problem successfully. 2. To recommend the most practical and economical equipment suited to the job, and, 3. To give a stand-by consulting service in securing maximum benefits from the equipment.

securing maximum benefits from the equipment.

Yes! When you have a problem in filtration, Eimco can help whether or not you can send a sample.

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In the chemical processing industries, CO₂ is a real "trouper" which can be made to perform in imaginative and diverse ways. As a refrigerant it is unsurpassed. It's dependable, non-mechanical, "cold," with a wide temperature range. As an active ingredient it is indispensable for carbonation, PH control and foaming of rubber and plastic materials. And, as an inert atmosphere,

it is widely employed in the paint, pharmaceutical, packaging and chemical processing fields. These few examples just hint at the many applications for CO₂. We will be glad to discuss the possibilities of this versatile product for your particular processing method. Our wide experience in applying CO₂ to industrial problems is at your disposal.



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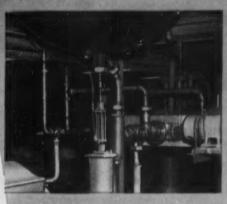


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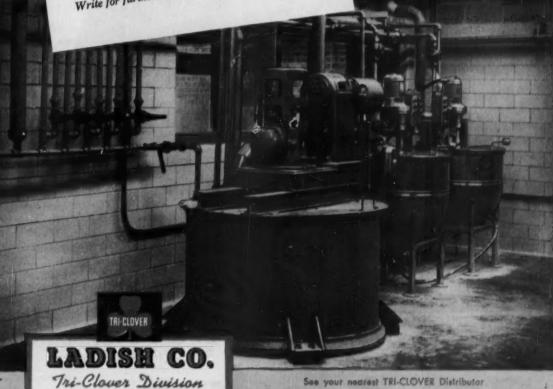
phases of operation.

In making aqueous base clay paper coatings, for example, A. B. DICK Company makes extensive use of Tri-Clover Division's sanitary type stainless steel fittings, compression valves, and plug valves, as well as Ladish Co. tube O.D. butt welding stain-

This is just one more good example of the way in which Tri-Clover fittings, valves, pumps and tubing serve industry by protecting product quality less steel fittings. and insuring full corrosion-resistant processing lines. Write for further details.



Shown below is the mixing room where Shown below is the mixing room where aqueous base clay paper coating is prepared, using Tri-Clover fittings and valves. The view above is a close-up taken from underneath the coating mixer, showing Tri-Clover fittings, compression valves, plug valves and air-actuated kettle valve.



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GENERATORS DEACRATING NEATERS EJECTORS

COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

Inco high temperature research note: Nitriding

...and its effects on several heat-resisting alloys

As a constituent of many hot atmospheres that employ air for combustion, nitrogen in molecular form is usually considered substantially inert to a large number of metals and alloys.

However, in atomic state—for example, as a transient dissociation product of ammonia — nitrogen may react with surfaces of certain metals and distinctly alter their properties. Whether this may be desirable or not, depends on extent and nature of the reaction.

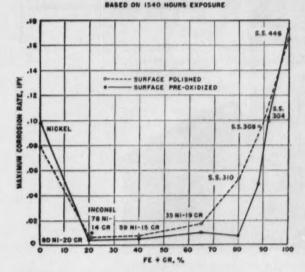
The Problems

Industry heats steels to be intentionally nitrided, in a freshly dissociated ammonia atmosphere to attain the surface hardening that accompanies formation of nitride phases. But the problem is, to avoid nitriding the furnace chamber, dissociator and other accessories . . . a costly and useless consumption of gas. Another problem exists in chemical plants, where equipment handling hot ammonia must resist the absorption of nitrogen. Here nitriding is a form of high temperature corrosion requiring selection of the most resistant alloys for its prevention.

A Postulate

Field experience had shown that alloys high in nickel resist corrosion and embrittlement by nitrogenous atmospheres. However, to evaluate lower nickel alloys

CORROSION OF NI-CR-FE ALLOYS BY ANHYDROUS AMMONIA AT 500°C



in this type of service, a series of commercial compositions was exposed in a plant ammonia line and the corrosion behavior thereafter compared.

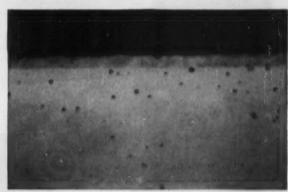
Examination

After 1540 hours' exposure at 500°C, stainless steels having initially a bright surface suffered heavy corrosion that was quantitatively measured by examination of the specimen cross section under the microscope.

These measurements were calculated in terms of "inches penetration per year" and the variation in extent of attack with alloy composition is shown in the graph.

When the nickel content is high, as in 80 Ni/20 Cr, 78 Ni/14 Cr (Inconel* nickel-chromium alloy), or 59 Ni/15 Cr, the nitride phases which form are dense and adherent and the corrosion resistance is correspondingly good. Alloys that contain more iron develop porous surface layers and the rate of attack is high. Significantly, apparently some chromium is required to provide corrosion resistance, since under these conditions of exposure, pure nickel is inferior.

An interesting observation from this test is that the stainless steels which were initially heat-treated to form an oxide film were more resistant than specimens with a bright surface.



Material Magnification dark zone nitride rich corrosion layer.

Result of Investigation

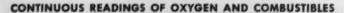
Quantitative data obtained from this test in general support past experience that the high nickel compositions are inherently suited for service under nitriding conditions.

Inco has investigated hundreds of metals and alloys under high temperature operating conditions. If you have a metal problem involving high temperature performance in corrosive media, let us help you. Send for our High Temperature Work Sheet . . a form that makes it easy for you to outline your problem to us. Use the coupon now.

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The famous Cities Service HEAT PROVER Analyzer, formerly available only on loan, is now manufactured by Bailey Meter Company, and you can buy one outright. With this handy portable instrument, you can easily monitor the per cent of oxygen and combustibles in gases.

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The two meters on the analyzer show per cent by volume of oxygen and combustibles on either a 20% range span or a more sensitive 4% range. Temperature of flue gases in degrees Fahrenheit is also shown.

Compared with involved, time-consuming Orsat measurements of flue gases, this new portable analyzer offers these advantages:

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 Continuous sampling, analysis, and readings.
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Ask your Bailey engineer how you can use this instrument to increase combustion efficiency. Or, write today for more information on how this new Bailey HEAT PROVER Analyzer can pay for itself practically at once.

G-39-1

Flue gas analysis with a Bailey HEAT PROVER Analyzer at a furnace stack. Per cent oxygen and combustibles is shown continuously.

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GR	OUP	I.	11.	111,	IV,	V _b	VI _b	VII		VIII,		1		11,	111,	IV.	Va	VI.	VII.	VIII,
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	6	Cs	Ba	La	Hf	Ta	V	3)5	K	P	X	U	9	J	1 p	31	Po	At	Rn
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					A Ser	C	Th	Pa	U	Np	Pu	Am	Cr	n B	k C	F				

Lithium, by reason of its atomic configuration and general characteristics, is rightfully included as the first member of Group I in the Periodic Table. A detailed study of the properties and reactions of both the elements and their compounds, however, shows that Lithium often resembles the metals of Groupa II and III more closely than Group I. Following are some characteristic differences:

Lithium differs in organic chemistry . . .

because its organolithium compounds form a unique class with stability, solubility and activity characteristics intermediate between those of the Group I and Group II organometallic compounds.

Lithium also differs from the other alkali metals in that it serves as a unique catalyst for the polymerization of diolefins to materials of definite and predictable structure. It directs, for example, the polymerization of isoprene predominantly to 1,4 addition structures.

Again, recent investigations have indicated an interesting potential as a direct reducing agent in solvents such as ammonia, low molecular weight amines, and ethylenediamine.

Lithium differs in metallurgy... inasmuch as the affinity of Lithium for oxygen, for example, is being utilized to reduce porosity in copper and copper alloy castings. Recent research has revealed that Lithium will produce brazing alloys with self-fluxing properties and increase the wetting ability of these alloys.

Lithium differs in inorganic chemistry . . .

the usefulness of Lithium Hydride and Lithium Aluminum Hydride in the preparation of other hydrides having already been widely demonstrated. Recent studies indicate that other complex hydrides prepared in a similar manner may prove to be interesting tools for research. The low dissociation pressure of Lithium Hydride at its melting point, to cite a specific example, is unique among all hydrides. LiH also has some slight solubility in polar organic compounds which is again unique among alkali metals.

Lithium differs in heat transfer . . .

based on its physical properties it has no equal as a liquid metal coolant. Due to corrosion caused at elevated temperatures by impurities in commercially available Lithium and Lithium Metal, Lithium has thus far found only experimental use.

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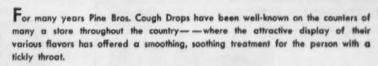
A smoother operation

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Ro. WILD C

Ducts bringing pulverized material to two MIKRO-COLLECTORS, each with its individual storage bin to hold material for following processing step.

MIKRO-PULVERIZER grinding materials for Pine Bros. Cough Drops at Life Savers Corporation, Port Chester, N. Y.



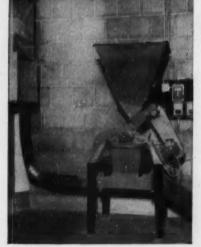
Today, several processing steps of this division of Life Savers Corporation, have likewise been smoothed out. For here, a brand new MIKRO-PULVERIZER has been installed feeding to two likewise new MIKRO-COLLECTORS.

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SEND FOR your copy of Bulletin 55, describing the workings of the MIKRO Laboratory, and the MIKRO Test Grinding Data Sheet.





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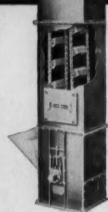


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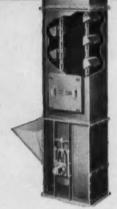
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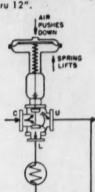
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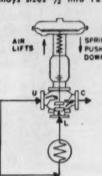
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Reynolds Metals Company, recognized as a leader in the aluminum industry, uses 80-20 alloy Wissco Rod Reinforced High Temperature Belts in this production-line operation at its Louisville plant.

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CHEMICAL ENGINEERING—September 1956

167

BLAW-KNOX Autoclaves furnished in a size and type

... for every pressure and temperature application

with all auxiliary equipment, when desired, for a complete high pressure plant

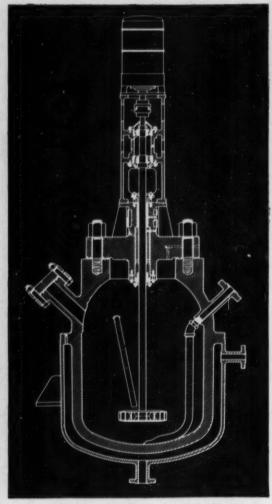
Blaw-Knox has designed, constructed and equipped autoclaves in all practical sizes, ranging from one quart capacity upward to the largest commercial sizes with total capacities of several thousand gallons.

Pressure requirements range widely from vacuum and atmospheric operations up to several thousand pounds per square inch. Temperatures, where required, cover a full range starting at sub-zero temperatures and going as high as commercial needs dictate, some operating at 800° F. and higher, with heating methods ranging with the temperatures to be reached.

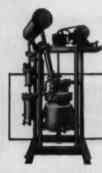
Any suitable material of construction is used, the choice depending on the materials and conditions of the reaction under consideration. Many different agitator types are available to meet every conceivable mixing requirement.

In other words, Blaw-Knox has the engineering knowledge and skill and the manufacturing facilities to build any size, any type autoclave or kettle for use for hydrogenation, ammonolysis, polymerization, or organic synthesis, for batch products of chemicals, drugs and medicines or resins, and for general chemical processing.

No matter what your reaction problem is, whether with low pressure—low temperature, or highest pressure—high temperature conditions, why not discuss it with us. We will gladly give you our recommendations.



Drawing of a Blaw-Knox 120-gallon Steam Jacketed Autoclave, with turbine agitator, for processing organic chemicals at a pressure of 2000 psi and a temperature of 300° F.



Photograph of a Blaw-Knox 15-gallon Electro-Vapor Processing Kettle, widely used in the resin and chemical industries.

Ask for Catalog 2413-R.

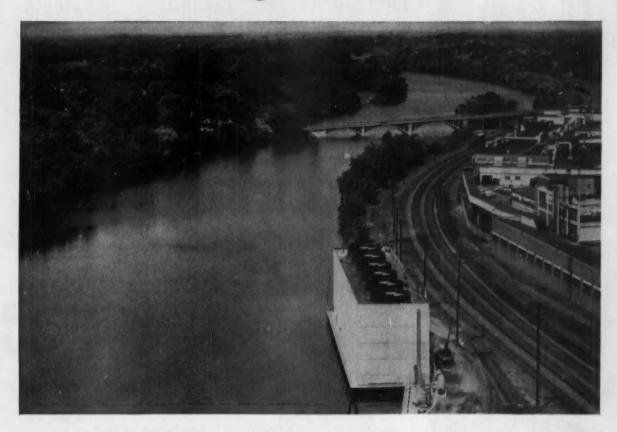


BLAW-KNOX COMPANY

Buflovak Equipment Division, 1551 Fillmore Avenue, Buffalo 11, N.Y.



COOLING TOWER Cooling a River?...Yes!

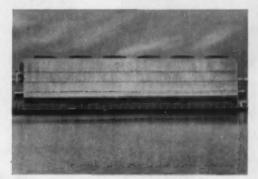


THE Board of Water and Electric Light Commissioners, Lansing, Michigan required 32,000 GPM additional circulating water capacity in order to add a new steam electric generating unit at the Moores Park Station. River flow during the summer months was in-

sufficient, however, to meet the requirements of this rapidly growing load. A cooling tower installation proved the economic solution, in preference to relocating the new generating facilities. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

Pleasing architectural appearance of the tower was also an important consideration because of a municipal park across the river.

A Foster Wheeler six cell induced draft tower with cement asbestos board casing and stainless steel trim was chosen for this unusual installation.



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Lectrobreathers* safeguard chemicals

You see Lectrobreathers extending above tanks and rooftops at the Abbott Laboratories plant in North Chicago, Illinois.



Where volumes of air are large, as in a tank farm, a Lectrodryer* serves as a breather. Its DRYing-reactivation cycle is continual, so it stays right on the job.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

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· Buying liquids in tank car lots saves money. But profits are quickly washed out if storage tanks are allowed to inhale wet air as they breathe, contaminating their contents.

Abbott Laboratories solved this problem by installing Lectrobreathers on many of their outdoor and indoor storage tanks. Now, as pressures vary and those tanks draw in outside air, that air is DRY. The original high quality of their contents is preserved.

Lectrobreathers and Lectrodryers make certain that any tank, little or big, breathes only DRY air. For help in selecting the equipment you need, write Pittsburgh Lectrodryer Company, 303 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).

A tank breathes freely as air passes through the Activated Alumina ad-sorbent and is dried DRY. When a Lectrobreather needs reactivation, it is lifted off and a spare takes its place.

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LECTRODRYER



... loading is smooth and there's a scooping action with tip-back bucket.

... mobile ramp is pulled from bin to bin by the Tracto-Loader.

SAVES 21 MAN-HOURS UNLOADING BOXCAR

with compact TRACTOMOTIVE TL-6 TRACTO-LOADERa high producer in confined areas

A boxcar of bulk materials is now unloaded in two to three hours with a TL-6 Tracto-Loader at Cambridge Tile Manufacturing Co., Cincinnati, Ohio - manufacturer and national distributor of Suntile, a fine clay tile for homes and industrial buildings. This includes the time it takes to spot a mobile ramp and set up a portable belt conveyor and hopper. The former hand labor method took 24 man-hours to empty a car!

The mobile ramp is pulled from bin to bin by the Tracto-Loader . . . then this compact, half-yard machine drives up the ramp and makes a right angle turn over a bridge into a boxcar. Its short, 61/2-foot turning radius enables it to scoot around easily in the car. There's no time-consuming gear shifting, either - a pull or push on

a single lever changes direction of loader.

The TL-6 gets big loads and delivers 'em to hopper fast. Instead of ramming to get load, operator lets the hydraulic torque converter do the crowding. It's smooth and positive . . . and there is a scooping action with the tip-back bucket. The full load is tucked in close to the cowl with the 50-degree tip back of bucket and carried means greater stability, better visibility, easier maneuvering.

See how the TL-6 can speed up the handling of bulk materials in your plant - even in the most confined areas. Arrange with your Allis-Chalmers Construction Machinery Dealer for a demonstration.

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☐ Please arrange a demonstration of the TL-6

Send catalog on Tracto-Loaders



Sand and Ground Glass Solution

60 feet straight up

with dependable De Laval CPO Pumps



These De Laval CPO Pumps are at work 24 hours a day, 7 days a week

Here's proof of the dependability of De Laval CPO Pumps. In one large automotive company, glass grinders work 24 hours a day, 7 days a week virtually every week in the year. They cannot grind without the sand and ground glass polishing compound which must be pumped 60 feet straight up and over to a grinding room. Says the supervisor, "We have encountered no trouble at all, nor has there been any downtime for the grinders due to the pumping operation."

These pumps have cast iron casings with De Laval KK-20 (20-28 stainless) internals. This superior metal is also being used successfully on other problem fluids which require KK-20 for the casing as well.

Three bearing pedestals accommodate nine wet end sizes of the De Laval CPO, and changes in size or metallurgy can be made after installation with off-the-shelf parts. Either conventional or mechanical seals are available.

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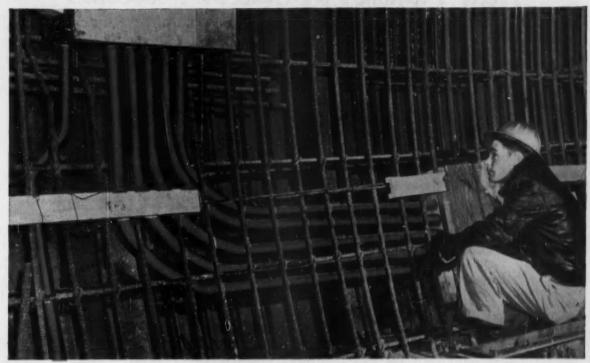


DE LAVAL CPO Process Pumps

DE LAVAL STEAM TURBINE COMPANY

803 Nottingham Way, Trenton 2, New Jersey

Power for the new 7,650-foot Baltimore Harbor Tunnel will be protected by EVERDUR Electrical Conduit



Everdur Electrical Conduit, nominal size 11/4", connecting control box to sidewalk manhole-all conduit to be embedded in concrete.



A section of Everdur Conduit in the roadbed slab protects the vital traffic control system and air duct lighting.

THE BALTIMORE HARBOR TUNNEL†, under the Patapsco River, scheduled for completion in 1957, will be the largest "trench-type" tunnel ever built. Twin-tube sections are built on dry land, launched and concreted almost to zero buoyancy, then sunk in place and joined underwater by divers.

Power for traffic signals, alarms, air duct lighting, and shaft lighting circuits for this great tunnel will be protected by Everdur* Electrical Conduit—made from one of Anaconda's copper-silicon alloys. Everdur never rusts—offers high resistance to other types of corrosion. It provides dependable year-after-year protection—wherever water and corrosive atmospheres are a problem—or where conduit must be buried or embedded in concrete. Everdur is also tough—stands up under movement and vibration.

For detailed information, write: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Limited, New Toronto, Ontario.

*Reg. U.S. Pat. OS. 60324

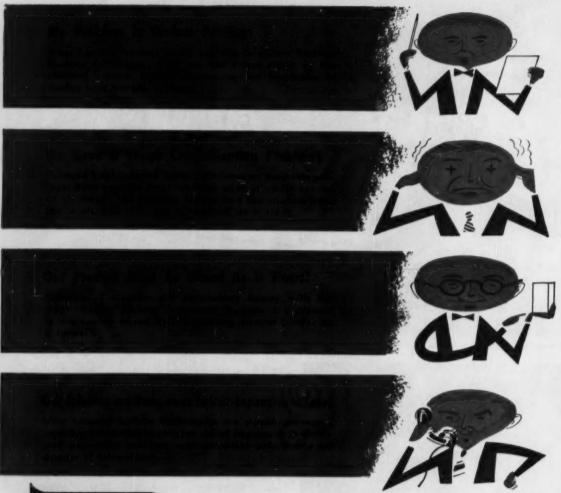
†Built by Maryland State Roads Commission; Merritt-Chapman & Scott Corp., General Contractors; Singstad & Baillie, Contracting Engineer; J. E. Greiner Co., Consulting Engineer

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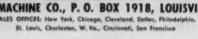


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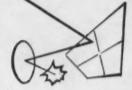
HENRY VOGT MACHINE CO., P. O. BOX 1918, LOUISVILLE 1,





Solar Energy

What This Inexhaustible Supply May Eventually Mean to Chemical Engineers



GEORGE O. G. LÖF, Chemical Engineering Consultant, Denver, Colo.*

During the last three or four years, there has been a remarkable increase in interest in the development of solar energy for many uses now being met by combustion of our steadily diminishing fossil fuel supplies. As these energy sources become scarcer, their costs rise. At the same time, research and development in solar energy utilization is leading to equipment cost reductions which should make solar energy competitive with other sources in many situations.

Although numerous fields of science and engineering are involved in the development of solar energy in its manifold applications, chemical engineers have been particularly prominent in the research and development activities of the past decade. The subject lends itself well to the type of training which chemical engineers receive, and there are several applications which are uniquely in their field. There is no reason to doubt that chemical engineers will play as prominent a part in the development of solar energy as they are playing in the application of nuclear energy to man's needs.

Until about a dozen years ago, the utilization of solar energy was generally considered of interest only to farmers and to a few visionary inventors. It is true that solar water heaters were in use in favorable climates, and sun preserves and sun-dried fruits were produced, but "artificial" utilization of the sun was infinitesimal in comparison with other sources of energy.

In the early 1940's, however, several research programs in the U. S. and abroad were directed toward the application of solar energy to various uses, and by 1950 engineers and scientists in many fields were giving it serious attention. Further stimulated by conferences and symposiums at MIT in 1950, at the University of Wis-

consin in 1953, and in Tucson and Phoenix, Arizona, late in 1955, research and development in solar energy utilization has moved out from the inventor's basement into some of our most progressive science and engineering laboratories.

Another stimulus to professional interest in the field is the tremendous increase in the consumption of energy and the fuels which supply it. Statistics and predictions, including those of the President's Materials Policy Commission, show that depletion of our fossil fuels will cause major increases in energy costs during the present century. Natural gas and petroleum will become scarce and may have to be rationed for "higher grade" uses. Nuclear power will supplant fossil fuels to a large extent, especially in large power installations.

But as our energy costs rise, and fuels become scarcer, solar radiation, the earth's only unlimited source of energy, will undoubtedly be increasingly utilized. The transition will probably not be abrupt, but rather gradual; conventional energy sources in various parts of the world will progressively be augmented and finally replaced by solar energy when their costs reach the point where the latter is more economical.

In his study for the Atomic Energy Commission, Putnam predicted at least 1 billion billions Btu. annual world energy consumption by the end of the century and five to six times that much by the year 2050. During the next hundred years, or by about 2050 A.D., man will use between 100 and 400 billion billions Btu. The known reserves of fossil fuels recoverable at no more than double present costs are estimated to be only 27 of these "BB" energy units, and estimated economically recoverable reserves of nuclear fuels, even assuming all practical breeding, are 575 BB units.

In addition to the stimulus given to solar

^{*} Meet your author on page 384.



Bell Labs' solar battery has had experimental use on rural telephone lines.

research by mounting fuel costs and predictions of fuel depletion, interest has recently been focused on certain unique applications of solar energy and on the potentialities of solar energy in the comparatively fuelless arid regions of the world. It is in relation to these applications that chemical engineering should be most concerned.

Although we may logically subdivide the utilization of solar energy in several different ways, perhaps the best for our purpose here would be the four principal fields of (1) heat, (2) electrical and mechanical work, (3) synthesis and separation of chemical materials, and (4) growing food and conducting other biological reactions.

Solar Energy as Heat

Heat from the sun, used as such, will doubtless continue to be the largest application

Probably the largest potential application of solar energy and also the earliest major use will be in comfort heating of homes and other buildings. Over one-third of all the world's energy consumption is for this purpose. Since the temperature requirements are relatively low, this use is attractive. The general principles of conversion of solar energy to sensible heat in air or water are every-day tools of the chemical en-

gineer, for basically the so-called solar "collector" is a heat exchanger. Storage of heat as sensible heat in water or gravel, or as latent heat in fused salts for subsequent night-time use, also involves fluid flow and heat exchanger design. Hot water heating falls in the same category. Considerable fundamental and development work is being done in these areas by chemical engineers. As developments mature, factory production of solar heating equipment will require the talents of chemical engineers for design and improvement.

Although probably of only very long range interest, the use of solar energy as process heat in the manufacture of chemicals and other products may eventually be important. The intermittent nature of solar energy will of course require auxiliary heat sources, and their integration with the solar source will be involved. It is probable that any substantial application along these lines would not precede a situation in which fuels became very scarce and expensive.

Solar Energy for Power

Electrical and mechanical energy from the sun will eventually offer opportunities

Power production generally falls in the area of mechanical and electrical engineering, but there are many opportunities for chemical engineers in these fields. This situation is clearly evident in the development of nuclear power where the chemical engineer is playing an extremely important part. And although the economics of work production from solar energy are unfavorable in the U.S. at the present time, there are two situations which could involve early applications, and there is one long range potentiality. One of the early prospects is for small solar power units of only a very few horsepower, which would be useful in areas where fuel is already very scarce and expensive. Use of such facilities in rural areas or small communities for water pumping, refrigeration, and lighting can be predicted. Most needed are technical developments in energy storage and in heat engines which are simple and cheap but not necessarily highly efficient.

The direct conversion of solar energy to electricity is another early

possibility, but it now appears to be limited to uses requiring only small amounts of power. The remarkably successful development of the "solar battery" by the Bell Labora-tories should find application in communications systems, where energy requirements are small, and in locations where other power sources are either unavailable or extremely expensive. The very high cost of the silicon disks used as energy converters now appears to preclude their use for large power supplies, but the development of more economical methods for producing these materials or the substitution of entirely different and cheaper materials is a challenging opportunity for chemical engineers.

The cadmium sulfide cell of the U. S. Air Force is another illustration of the role of chemicals and chemical engineering in the development of electronic equipment. Further possibilities are those involving thermoelectric effects, as in the common thermocouple, which offer possibilities in sun-powered communication systems. Introduction of cheaper and more efficient alloy pairs through fundamental chemical and metallurgical studies would enhance their prospects.

Extreme variability and large collector area requirements make the use of solar energy for central station power generation highly unattractive at the present time. A typical U.S. location would require a solar collecting area of about 3 sq. mi, to supply the heat for a 100,-000 kw. power plant. Furthermore, some means for storing a portion of the day-time heat supply or power output for night-time use would have to be provided. In rough figures, an investment of over \$100 million would be required, exclusive of energy storage means. At present prices, fuel savings would not be great enough to amortize this tremendous investment. The development of economical energy storage, possibly in some chemical form, will be one of the most vital requirements of future solar power plants.

Solar Energy for Chemicals

Sun energy will serve both as a low-temperature source and for very high temperatures

Direct use of solar energy in the production and separation of chem-

ical products and its application via the unit operations are of special interest to the chemical engineer. Progress in these fields has been very limited until the last dozen years, but we now see substantial research and development along these lines.

The field may be conveniently subdivided into processes using solar energy at low to moderate temperatures and those requiring very high temperatures.

Moderate Temperature Uses

Probably the oldest application of chemical engineering in the production of a chemical compound is the manufacture of common salt by solar evaporation of sea water and brackish lakes. In a favorable location, an average school input of 2,000 Btu. per sq. ft. per day can be obtained, resulting in the net evaporation of 1 to 2 lb. of water. This is equivalent to 6 to 12 in. of water per month which would result in the production of 200 to 400 tons of salt per acre of evaporating basin per year.

The principal improvements in this process over the centuries of its use have been primarily in the mechanical equipment for harvesting the crystallized salt in the secondary purification steps. There has also been some development work in Israel directed toward increasing the efficiency of solar evaporation. It has been found that the addition of small amounts of dye to the water can cause a substantial increase in the amount of solar energy absorption by reducing the reflection back to the sky from the very white salt deposit on the bottom of the basin. Yield increases of 40% have been obtained by dye addition to the saline water feed.

Fresh Water by Solar Distillation—If salt water is evaporated under sloping transparent glass covers, vapor will condense on these surfaces and run to their lower edges where the distilled water can be collected. Although this process has been known for a century, substantial development has only taken place within the last few years.

Solar distiller designs recently and currently being studied are simple, direct solar-heated, singleeffect evaporators. The sun's radiation is absorbed in a shallow basin containing salt water. The water, at temperatures from 100 to 150 F.,



Consolidated Vultee Aircraft Corp. uses this 120-in. diameter solar furnace in California for materials testing at temperatures up to an estimated 8,500 F.

evaporates slowly into the air space and condenses on the air-cooled cover glasses. Distilled water then collects in channels at the lower edges of the glass covers. A portion of the unevaporated saline water is run to waste to minimize salt crystallization and cleaning of the basin. Under average solar conditions in favorable U.S. locations (southwestern U.S.), about 1 lb. of water can be distilled per square foot per day, corresponding to a daily production of about 5,000 gal. per acre.

Since there is no energy cost, the initial investment and its amortization constitute the principal expense of water produced by this method. Simplified design and construction economies should bring the total investment below \$1 per sq. ft., and solar distilled water could be produced for less than \$1 per 1,000 gal. Although this is considerably above the cost of present municipal supplies in the U.S., there is every reason to expect that the difference will decrease and finally disappear entirely. Of particular value would be the development of a cheap weatherresistant plastic film which might be used in place of glass.

Photochemical Energy Storage— Probably the greatest limitation to the use of solar energy as a power source is its intermittent nature. If there were some simple, economical way for efficient conversion and storage of solar energy, the practical possibilities for its application as a work source would be greatly enhanced. Electrical storage batteries appear much too expensive, and the day-time pumping of water to an elevated reservoir by solar generated electricity for subsequent night-time release through turbines would probably be restricted to certain unique sites. Although there are additional economic obstacles, this storage problem is certainly one of the most formidable that must be met.

A second drawback in the application of solar power is the low efficiency of converting this highly diffuse radiant energy to electricity by means of combinations of solar collectors and heat engines. At the 5% efficiency heretofore obtained, or even at a probable maximum of 15%, solar collector areas must be large and comparatively expensive. If most of the energy in sunlight could be directly absorbed in an endothermic chemical reaction which could later be readily reversed and the energy given back as heat or power, an efficient energy converter as well as a convenient energy storage means would be available.

Although no photochemical reactions have yet been accomplished at high over-all solar conversion efficiencies, several possibilities are



Solar engine of about 1½ hp., built by Societa Motori Recuperi, of Lecco, Italy, was displayed at Phoenix. Vapor from low-boiling-point liquid drives a piston.

indicated by chemical changes which have been induced by the ultraviolet portion of the solar spectrum. By means of artificial ultraviolet radiation, water has been decomposed into hydrogen and oxygen in the presence of cerous and ceric perchlorate catalysts. Actual efficiencies of conversion, even based on a pure ultraviolet source, have been very low. However, the potentialities of this and comparable processes are so great that much more research and development in this area will be justified.

Another interesting photochemical-electrolytic reaction takes place between ferrous ions and certain dves such as methylene blue and thionine. When irradiated, the dye is reduced to a colorless form while the iron is oxidized to the ferric state. In the dark, the reaction reverses. The process can be carried out in two cells, one of which is in the light and the other darkened, so that an electric current can be generated between electrodes placed in the two portions of the solution. Here again, efficiencies have been extremely low, but the possibilities are most interesting. Even photosynthesis itself, or perhaps at least the key radiation-absorbing steps, may ultimately be accomplished at high efficiency outside the living cell.

Probably the most formidable

problem in solar photochemistry is the discovery and development of compounds and reactions which can absorb and utilize much more of the solar spectrum than merely the small ultra violet fraction heretofore employed.

Synthesis of Special Chemicals—Although sunlight has long been used in photochemical reactions, such as in the halogenation of aromatic compounds, the production of certain special chemicals by photo excitation of organic molecules and selected parts of molecules is comparatively recent. Compounds hitherto not synthesized have been prepared by this means.

One type of photochemical reaction takes place in liquid systems at room temperature between compounds containing multiple bonds. The absorbed light supplies activation energy for compound rearrangement and additions, produc-ing large molecules which may be difficult to synthesize by other means. Other reactions which have been carried out in the research laboratory with sunlight have involved oxidation (in the presence of a sensitizer such as chlorophyll or eosin), oxidation-reduction exchange between aromatic ketones and isopropyl alcohol to produce pinacols and acetone, addition of olefins and aldehydes to quinones, photochemical decomposition of quinonediazides resulting in loss of

nitrogen and production of fivemember ring compounds from the original six-membered rings.

Although there are questions of economics and of continuity, sunlight might be used to advantage if the wave length of the energy required was unknown or if high intensities were needed for a short period of time. Commercial production of specialized chemicals by solar and artificial irradiation may become more significant as particular requirements for these products develop.

High Temperature Processes

Some of the highest sustained temperatures ever produced have been obtained despite its diffuseness by focusing solar radiation into a small zone. Although in the same general range of maximum temperature as the electric arc furnace, there are certain advantages to the solar furnace such as the ease of employing controlled atmospheres, freedom from contamination by container materials and electrodes, and the absence of electric and magnetic fields. When temperatures in excess of 3,000 C. are required, the solar furnace can be an exceptionally useful research tool. Practical maximum temperatture of about 3,500 C. can be obtained with such units if well designed.

Ceramics, Alloys and Refractories Several solar furnaces already built and others in the planning stage have been used primarily for high-temperature research work in the fields of ceramics, cermets and alloys. The 35 ft. segmented solar reflector at Mont Louis, France, the 28 ft. segmented unit in Algeria, and the 10 ft. mirror in San Diego (designed by Conn and owned by Convair) are among the principal large solar furnaces. At Mont Louis, refractory materials such as thoria and zirconia (melting respectively at 3,000C. and 2,700 C.) have been purified by melting processes. Another interesting application is the preparation by fusion or high temperature reaction of boron carbide (m.p. 2,450 C.), titanium boride (m.p. 2,900 C.), boron nitride (m.p. 3,000 C.) and titanium carbide (m.p. 3,140 C.).

Chemicals in Solar Furnaces— Some progress toward actual chemical manufacture in solar furnaces is being made. Despite intermittency and high investment the unique conditions obtainable in solar furnaces may offset these disadvantages in the preparation of chemicals, alloys, ceramics, and other materials not readily prepared in electric arc furnaces. For example, the large solar furnace in France has been used for semicommercial production of special refractories. One of the planned uses of the Algerian furnace is the study of the commercial production of nitric acid from atmospheric nitrogen by passing air through the high-temperature focus of the reflector.

At present, costs of solar furnaces are high, and it is doubtful that this equipment can compete with others in the manufacture of the same products. There are possibilities for substantial cost reduction, however, and engineering improvements may make the production of certain chemicals and alloys by solar radiation entirely practical. Chemical engineers can expect to have an important part in such developments.

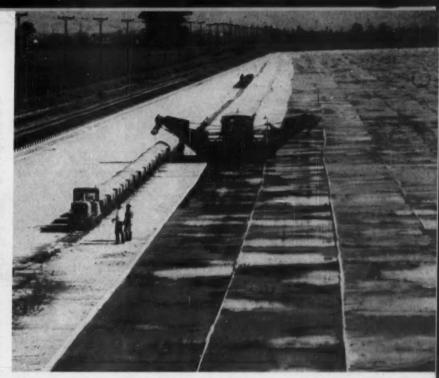
Solar Energy for Food

Growing algae as a high-protein food can be five times as efficient as normal farming

As world population continues its steady climb, the supply of foods grown directly and indirectly on the land for support of this population will become more critical. Authoritative opinions predict that in 50 to 100 years greatly increased productivity per acre of land will be required to sustain the anticipated population.

Experiments with the growing of simple water-borne plants known as algae have shown that under proper conditions, efficiencies of converting solar energy to food supply in algae greatly exceed the best known efficiencies for common agricultural crops. Under ideal conditions, nearly 10% of the total solar radiation can be converted to high protein food value in dry chlorella, a common type of algae, whereas annual solar utilization efficiencies in agricultural crops do not exceed 2%.

Basic requirements for production of algae as food for animals or humans are simple. In large basins, either open to the air or closed with a transparent cover, the algae-



Evaporation of water from salt ponds is an old solar-energy application. Shown here is harvesting equipment of Leslie Salt Co., in San Francisco Bay area.

bearing water is circulated and exposed to the sun. Carbon dioxide and small amounts of inorganic nitrogenous nutrients are the only materials consumed. Most of the required chemical plant is for finally separating the very small algae cells from the solution. Filters or centrifuges are used for primary separation, followed by drying equipment to de-water the final product. In addition, since the most productive strains of algae have an optimum growth temperature at about 80 F., there must be equipment for cooling the solarirradiated solution. Clearly, the "agriculture" of algae production is applied chemical engineering involving plant design, optimum conditions, process "plant" operation. control, and

It is believed that about 35 tons of dried algae can ultimately be produced per acre per year under favorable conditions. At this rate, it should be possible to reduce estimated costs in large U.S. plants from about 25 c. per pound to something approaching 15 c. per pound. By comparison, yeast from sulfite waste liquor sells for about 10 c., and other agricultural products of comparable food value range from 6 to 20 c. per pound. Development work in Japan and the more critical food situation in that country indicates somewhat more attractive possibilities for economical competition of algae protein with other human food sources.

Another possibility in the algae picture that has not even been explored is the production of special protein materials which could command a sufficiently high price to justify their manufacture even on a small scale. Medicinal products, dietary supplements, and special chemicals could require substantial enterprises.

There is much room for further development of existing processes, reduction in costs, biological improvement in algae strains, and so on. Although early use of algae as human and animal foods in the U.S. is not likely, there are parts of the world in which such needs and opportunities should soon exist.

Place for Chemical Engineering

The most common unit operations involved in practical solar equipment are heat transfer, drying, and evaporation. Heat transfer applications are of course numerous; the most promising include flat-plate solar collectors for house heating, water heating, and air conditioning. Basically heat exchangers, these units require the absorption of solar radiation on solid surfaces and the transfer of sensible heat from those surfaces to a liquid or gas flowing past them. Several variations in design have already

been developed and there are possibilities for others.

Another field for engineering ingenuity is the design of heatreceiving surfaces at the focus of reflectors for applications involving generation of steam or other vapors. This novel type of boiler will need much additional design attention if the development of small, cheap solar engines for water pumping and other simple uses in underdeveloped countries is to be successful.

Much chemical engineering design effort will be required in solar absorption refrigeration and air conditioning. The most promising applications fall into the two general categories. The first is simple. cheap, and perhaps intermittent, domestic food coolers for use by millions of people in many parts of the world where food preservation is presently impossible. The second embraces efficient air conditioners for use in warm and humid parts of the U.S.

Progress in the development of a simple food cooler is already being made. A two-chambered portable refrigerating vessel, containing a refrigerant and absorbent, can be regenerated once a day by placing one chamber at the focus of a 3-ft. aluminized plastic solar reflector and the other chamber in a container of cooling water. After about 2 hr. of distilling the refrigerant into the cooled chamber, the unit is placed in the cold box with the refrigerant chamber (evaporator) inside the box and the other chamber (absorber) outside. Refrigeration for 24 hr. then can be obtained, to be followed by regeneration the following day.

In the air conditioning of homes and other buildings, the application of solar heat to the operation of absorption refrigerators and the regeneration of hygroscopic solutions for dehumidification systems requires much chemical engineering knowledge and technique. Work on both methods of solar air conditioning has been commenced, and there is still a long way to go. This should be a particularly fruitful area for investigation, eventually leading to expanded markets for the products of both equipment and chemical industries.

The use of solar heat for the drying of agricultural crops, lumber, and possibly even such materials as peat, coal, and oil shale is going to become of more importance as fuel costs rise. Solarheated dryers need not be greatly different from those employing steam-heated air, but will require special design attention. In areas of the world where fuel is scarce and expensive, large scale solar drying should develop fairly rapidly.

When solar energy utilization comes, chemical process industries such as glass, steel, and cement, will be supplying materials for solar equipment. In addition to conventional construction materials, there will undoubtedly be requirements for new and special materials for certain solar applications. Among these may be plastics for solar reflectors (laminated perhaps to aluminized plastic films or thin metals); new and more resistant plastic films for solar distiller covers; flat-plate collectors, and so on. Other special requirements involve radiation-absorbing coatings, including the newly reported selective coatings which have high absorbtivity for solar radiation and low emissivity for infrared thermal radiation. Improvements in the methods for producing low-reflectivity glass surfaces, such as by the RCA etching process, will be extremely valuable in the development of efficient solar collectors.

Certain special requirements for metals and alloys needed in the manufacture of thermoelectric and photoelectric converters (so-called "solar batteries") will have to be met by production requiring the application of chemical engineering techniques in the reduction of raw materials, purification of intermediates, and research and development in new and more effective materials.

When we reach the point of algae culture, photochemistry, and photosynthesis, then nutrients, catalysts, and other supplements involving chemical engineering techniques will be required. The development of solar furnaces will probably require the production of super-refractories capable of withstanding the excessive temperatures. These are but a few examples of some of the new fields which should be opened up by any substantial application of solar energy.

Chemical engineers have already made an impressive record in solar energy development. The surface is scarcely scratched, however, and developments to come will undoubt-

edly dwarf those already made. Potentialities are unlimited, and there is every reason to expect that chemical engineering will have a very large role in their ultimate realization.

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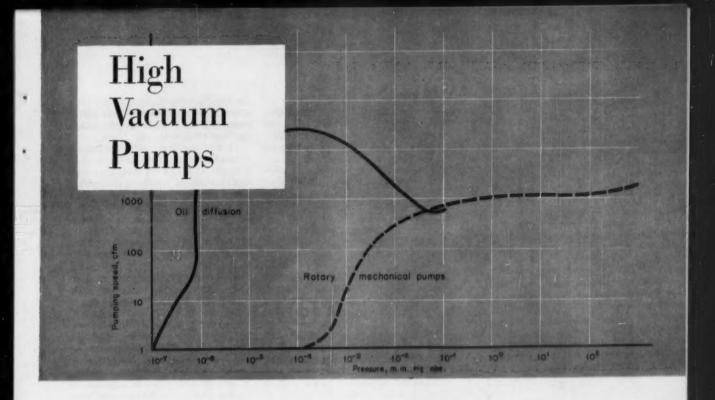
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Of late, high-vacuum production cycles have quickened their tempo. To keep pace, pumping equipment has been modified, specs tightened.

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New industrial vacuum processes developed widely during the past few years have increased greatly the demand for large-volume vacuum pumping equipment. With the increased demand have come more exacting equipment specifications to change the vacuum pump into a high-performance machine, able to keep pace with advancing technology.

In the not-to-distant past you might have considered a low blank-off ultimate pressure as sufficient indication of a pump's ability to meet operating conditions. But in mid 1956 that is not an adequate yardstick. Now, there are a number of other performance traits essential to modern processing.

Vacuum Pumps' Role

Actually, a vacuum pump is a low-pressure gas compressor installed to handle a mass flow of gas at a pre-determined operating pressure. Therefore, at this pressure it must have dependable pumping speed to move the required mass flow.

Modern vacuum processing

cycles are rapid. Faced with the resultant short cycle, the vacuum pump must have a quick recovery time or ability to draw the system down rapidly from atmospheric to operating pressure. And in many applications, oil in the pump must be kept free of contamination by condensing vapors in order to avoid interruption of production.

These requirements for modern vacuum pumps cover a very broad range of pressures—from 0.01 micron (10⁻³ mm. Hg) or less for electronic tubes and high-energy particle accelerators to several mm. Hg for vacuum impregnation and freeze drying.

For modern processing, vacuum pumping equipment varies considerably. The highest vacuum (lowest pressure) processes now use high-speed oil and mercury diffusion pumps having much greater capacity than those available as recently as 1940. For applications in the one micron (0.001 mm. Hg) pressure range, such as evacuation of radio receiving tubes and chambers for vacuum metallurgy, processors use very effectively the compound oil-sealed rotary vacuum pump. Where necessary, a refrigerated trap is used with it to prevent vapor from working back into the system.

Recently developed for the range from 0.1 micron (10-4 mm. Hg) to several mm. Hg is a mechanical booster pump, backed by a single-stage oil-sealed pump with interstage and high-vacuum traps. In this pressure range it is said to produce top volumetric efficiency and handle the greatest volume per unit total cost.

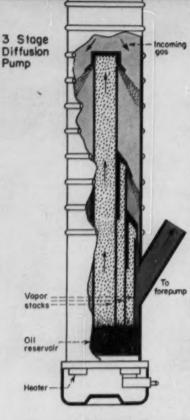
Repetitive operations in the range from a few microns to several hundred microns, such as dessication of organic materials, are handled well by single-stage oil-sealed rotary vacuum pumps together with appropriate refrigerated vapor traps. These units pump down rapidly and handle water and other condensible vapors at high speed.

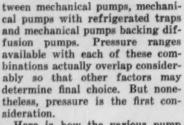
For coarse vacuum processes, simple single-stage oil-sealed rotary pumps can be used without refrigerated traps.

Pressure Key Selection Factor

Operating pressure must be considered first when choosing be-

^{*} Meet your author on page 385.





Here is how the various pump combinations line up by pressure

1) Down to 50 microns (0.05 mm, Hg)—single-stage oil-sealed rotary pump. Refrigerated traps are used only if evolution of water or other vapor is inconveniently large.

2) In the range from 50 to 10 microns (0.05 to 0.01 mm. Hg) total pressure, including permanent gas plus vapor, use single-stage or compound oil-sealed pump plus a refrigerated trap. The trap is needed particularly if high efficiency is required near the 10-micron limit.

3) For the pressure range from 10 to ½ micron (0.01 to 0.0005 mm. Hg) the choice is a compound oilsealed pump with refrigerated traps or a single-stage pump backing a diffusion pump. The latter is chosen if large amounts of gas are expected to evolve continuously in the low pressure range. The former is used if only a small

amount of gas is evolved after pump down, but frequent pump down is required.

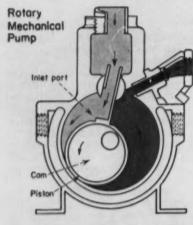
4) For operation over the broad pressure range from 1,000 to 0.1 microns (1 to 0.0001 mm. Hg) the combination of mechanical booster and backing pump is available. This unit can have an interstage refrigerated condenser. If extreme freedom from vapor contamination is necessary, a liquid-nitrogencooled vapor trap can be provided at the high vacuum inlet.

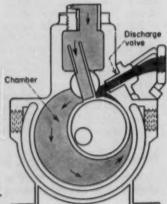
5) Pressures below 0.001 micron (10⁻⁷ mm. Hg) are attained with a diffusion pump backed by a single-stage mechanical pump. A refrigerated trap sometimes is used on the high vacuum side of the diffusion pump. Such a trap may be used also between the diffusion pump and the mechanical pump if considerable vapor is expected to evolve. Also, it will prevent contamination of the backing pump oil by vapor from diffusion pump.

For very large diffusion pumps operating on high speed systems excellent fore-vacuum pumping speed can be provided by the mechanical booster and backing pump combination.

Rotary Mechanical Pump

Oil-sealed rotary vacuum pumps, referred to herein, generally are





Where High-Vacuum Equipment Fits Into Industrial Processing

Process	Pressure Range, mm. Hg	Equipment Used, Alone or Combined
Vacuum metallurgy Degassing Casting Distilling Brazing	10 - 10-4	Mechanical pumps, mechanical boosters, diffusion pump boosters, oil ejectors, steam ejectors, diffusion pumps.
Electronics Evacuation of tubes Degassing of components Metallizing Gettering	10-4 - 10-4	Mechanical pumps, diffusion pumps, cold traps.
Metallizing Continuous films Plastics Fabrics Decorative finishes	10→ - 10→	Mechanical pumps, mechanical boosters, diffusion pump boosters, diffusion pumps.
Optical films	10-4 - 10-8	Mechanical pumps, diffusion pumps, cold traps.
Vacuum drying	10 - 10-8	Mechanical pumps, mechanical boosters, cold traps, diffusion pump boosters.
Vacuum distillation	10-1 - 10-1	Mechanical pumps, diffusion pumps, cold traps.
Vacuum impregnation	10 - 10-1	Mechanical pumps, cold traps.
Particle accelerators	10-4 - 10-9	Mechanical pumps, mercury (or oil) dif- fusion pumps, cold traps.

either of the vane or rotary-piston type. Variations of these two types are offered by many manufacturers producing rotary high-vacuum pumps.

In general, the vane-type pump is available in sizes under 40 cfm., although a few manufacturers build this type in larger sizes. The rotary piston pump is available in a wider range of capacities.

Due to the difference in design features there will be variations in the medium used for sealing and lubricating the pump. It is important to remember that a vacuum pump cannot create a lower total absolute pressure than the vapor pressure of its sealing oil.

Therefore, it is suggested that the manufacturer's recommendation be followed when you select a fluid for this purpose.

Compound pumps usually are built with both stages in one casing. There are some manufacturers who achieve the same result by connecting two single-stage pumps in series.

Mechanical positive-displacement booster pumps are used as the high vacuum stage in the low-pressure range where single-stage oil-sealed pumps have poor volumetric efficiency. One such pump, operating into a fore-vacuum created by a single-stage oil-sealed pump, provides a limiting pressure of less than 0.1 micron and a pumping speed of 1,000 cfm. in the pressure region from 10 microns to 0.5 mm. Hg.

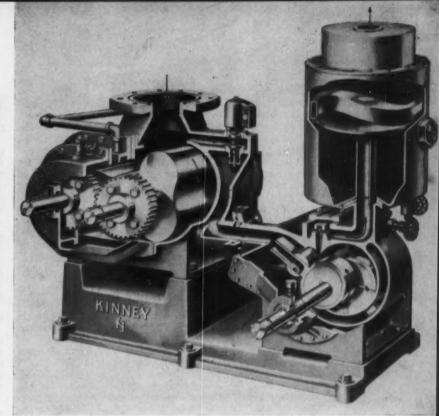
Does System Have Condensibles?

In the operation of mechanical vacuum pumps the type of gas or vapor system has a profound effect on the choice of pumping equipment. We have classified the types of vacuum system encountered into three broad categories:

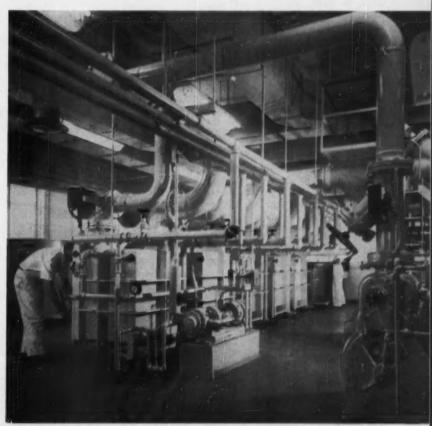
1) Fixed or permanent gases only.

Mixture of gases and condensible vapors.

3) Mainly condensible vapors. Wherever there are condensible vapors there is the possibility of contaminating the sealing oil in the pump. Then, unless precautions are taken to avoid such contamination, the pump must be shut down to change oil in order to maintain desired pumping characteristics. Many production schedules today cannot tolerate interruptions.



TWO-STAGE lobe-type pump backed by rotary covers wide range.



VACUUM pump, right foreground, evacuates drying ovens in drug plant.

In the case of a dry system (category 1 above) there is no serious contamination problem. The other two types of systems frequently present more complex contamination problems. However, these can be solved satisfactorily.

Solutions to the contamination problem are many and vary with the quantity and type of vapors, pressure, temperature and time. Some of the available methods for combating contamination are gas ballasting, air stripping of the oil to purge it of contaminants, liberation of the vapors under vacuum in the air-oil separator tank, heating the separator tank, continuous reconditioning by filtration, trapping of the vapors ahead of the pump by water-cooled condensers or refrigerated traps and draining of condensate from the top or bottom of the separator tank, depending on the gravity of the sealing oil.

Diffusion Pump

Diffusion pumps have gone through various stages of development to meet changing performance specifications and overcome operational weaknesses.

Oil diffusion pumps were developed first to satisfy the need for greater pumping speed and lower vapor pressures than could be obtained with mercury diffusion pumps. With these pumps there was difficulty in providing the quality of fore-vacuum required for satisfactory operation.

This problem was overcome by using compound, mechanical fore pumps. Newer oil diffusion pumps are free of this shortcoming.

Mercury diffusion pumps have made a comeback with jet designs that permit handling extremely large flow of gas.

Any diffusion pump, whether mercury or oil, has a pumping speed that is practically independent of the fore-pressure, provided gas flow and system pressure are sufficiently low. In effect, the jet of a diffusion pump acts somewhat like an aspirator, but the molecular mechanism is different.

The jet surfaces of the pump direct the oil or mercury vapor molecules so that they traverse, in a slanting fashion, the pumping area between the jet structure and pump housing. These molecules have a large component of velocity toward the fore-vacuum side of the

pump. The density of these directed molecules is sufficient to prevent backward diffusion of air molecules from the fore-vacuum side to the high vacuum side of the pump.

On the other hand, motion of the directed molecules within the jet region permits air molecules to diffuse with reasonable freedom through the pumping area from the high-vacuum side of the jet toward the fore-vacuum side. So, the diffusion pump actually functions by permitting diffusion in one direction only—out of the high-vacuum space toward the higher-pressure space.

The pumping area of a diffusion pump acts like a somewhat imperfect hole into a region of nearly absolute vacuum or zero pressure. An actual hole into a region of zero pressure would admit all molecules incident upon it.

However, in a well-designed diffusion pump only about ½ of the air molecules incident upon it pass from the high vacuum side of the jet through to the fore-vacuum. The remainder are deflected back into the high vacuum region.

To arrive at a fairly reliable speed for a working pressure range, the annular pumping area can be considered equivalent to a hole into the zero pressure region that is approximately one-third as large as the actual annular pumping area. Such a diffusion pump is said to have a "H." efficiency rating of 33%.

The reason why a pump with this efficiency rating is considered to be a well-designed pump becomes apparent when we see what happens if more than it the incident air molecules pass into the fore-vacuum region.

If the flow of gas through the diffusion pump increases, the forevacuum pressure rises steadily. At some point, it becomes sufficiently high to deflect the oil or mercury molecules before they can traverse the jet area, forcing them from directed motion into the normal random motion of molecules.

With this partial breakdown of jet action, the air molecules start to diffuse backward from the forevacuum to the high-vacuum side. As the flow of air back into the system gradually increases, the jet "blows up" rapidly. Pumping speed of the diffusion pump drops off from full value to practically zero.

In older type oil-diffusion pumps, this blocking effect usually occurred in the range from 10 to 30 microns fore-pressure. Present-day oil-diffusion pumps block at a considerably higher fore-pressure. For the more usual types, this is at the 100-micron level and much higher for special booster pumps using special synthetic liquids and high heat input.

Tandem Traits

In designing a system consisting of diffusion pumps backed by mechanical pumps, it is necessary to recognize the distinctly different functions of these pumps in the over-all system.

First, the diffusion pump will not begin to function until the forevacuum created by the mechanical pump is below the blocking pressure of the diffusion pump. Until the blocking pressure is reached, the rate of pump down is determined entirely by the mechanical pumps. After the pressure has dropped below the blocking pressure, diffusion pumping speed rises rapidly to the maximum value. It remains at approximately that value, no matter how low the forevacuum may ultimately become.

Details That Smooth Operation

One thing to remember is that the convenience and operating economy of a vacuum system depends upon the accessories and auxiliaries which are included with the system. In particular, items to note are:

 Vacuum-tight valves in sufficient numbers to isolate and bypass portions of the system.

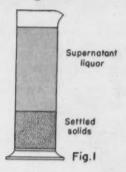
• Flanged connections with Oring seals wherever feasible to facilitate servicing and leak hunting.

 Gage connections for McLeod or Pirani gages directly at the mechanical pump, on the pumping line beyond the shut-off valve, and at any other points which can be isolated by closing valves.

 Sensitive Pirani or ionization gages for measuring total pressures less than one micron in highvacuum systems.

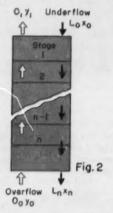
 Adequate refrigerated traps, either for systems requiring mechanical pump only or for systems with diffusion pump backed by a mechanical pump.

1 Find Separation Factor



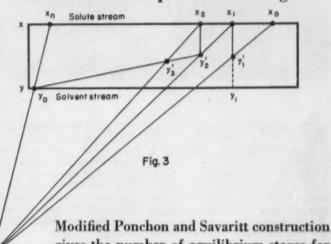
Mix solvent and solid and allow to settle. Separation factor is ratio of total solute in supernatant liquor to total extractable in original solid.

2 Make Material Balance



Material balance around column is in terms of underflow (solid) and overflow (solvent) streams.

3 Construct Graph to Find Stages



Modified Ponchon and Savaritt construction gives the number of equilibrium stages for liquid-solid extraction, works for selective or non-selective solids, changing flows.

How Many Stages to Extract Solids?

S. R. M. ELLIS, University of Birmingham, England*

If you are faced with designing a liquid-solid extraction such as recovery of oil from solids, wax from paper pulp or values from ore, you may calculate the number of equilibrium stages by one of a wide variety of methods.

Most of these methods are simplified by assuming that the solute diffuses completely from the solid to the solvent in the first stage. This is an example of a non-selective solid where the separation factor between the extracting solvent and the adhering solution is unity. Thereafter, in succeeding stages the process is one of washing the adhering solution from the solids.

If, in the washing process, the solvent phase is not saturated, mixing is uniform and complete and the solid is non-selective, then the graphical methods of Elgin, Ra-

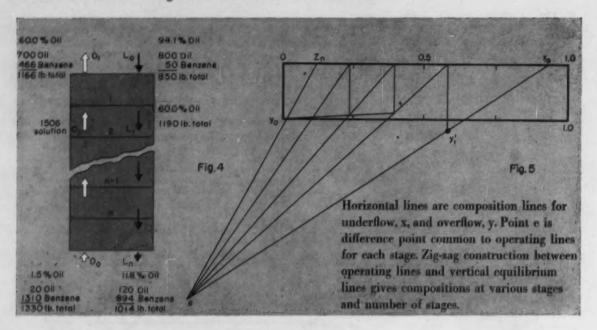
venscroft, Fitch, and Scheibel can be used.

These methods allow for a variation in the rates at which the underflow and overflow streams pass through the column. Flow rate varies because the weight of solution retained by the solid varies with composition of the overflow.

If, by further simplification, the weight of solution retained by the solid is assumed constant, the meth-

^{*} Meet your author on page 386.

Method verifies four stages needed to extract oil from meal



ods of Hawley and Baker can be used.

Recently, we have developed a modified Ponchon and Savarit graphical construction for determining the number of equilibrium stages, without the simplifying assumptions needed by other methods. It can be used for constant or varying flow rates, for incomplete mixing or when the solid is selective so that it adsorbs the solute.

First, Find Separation Factor

In working out the modified Ponchon and Savarit graphical solution for a given liquid-solid extraction, allowance can be made for the separation factor, provided it is determined experimentally. The separation factor is a measure of completeness of extraction and whether or not the solid is selective.

Armstrong and Kammermeyer' suggested a procedure to determine the weights of solution and of solute retained by the inert solids, expressed as a function of the concentration of the supernatant or overflow liquid.

Solvent is added to the solids which contain the extractable material. After agitation for a period of time that approximates predicted plant practice, the mixture is transferred to a graduated cylinder and allowed to settle.

Volume of the settled solids is subtracted from the total volume to give the volume of supernatant solvent. This value subtracted from the initial volume of solvent taken gives the volume of solvent held by the solids. Or, the true volume of the solids subtracted from the observed volume of sediment will give the same answer.

A portion of the supernatant liquid is withdrawn and analyzed for solute content. This value multiplied by total volume gives the amount of solute in the total liquid.

If there is no difference between the total amount of solute present in the supernatant liquid and that present originally in the solid, extraction from within the solid is complete and the solid is non-selective. Solution retained by the solid has the same composition as the supernatant liquid and the separation factor or equilibrium ratio is unity.

On the other hand, if there is a difference between the solute reported in the total volume of solvent and that present initially in the solid, the extraction either is incomplete or the solid surface is selective to the solute. When the weight fraction of solute in solvent retained within the sediment layer is different from the weight fraction of solute in the supernatant liquid the separation factor is not

unity. In such a case, since the value has been determined experimentally, it can be included as a correction or modification in the graphical construction.

How Method Works

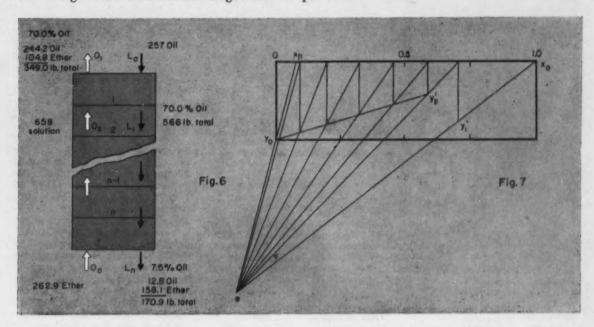
The terminology used in this method refers only to the solvent and the solute. At no point does the original solid which brings solute into the system enter into the construction of the graph. Thus, the overflow stream is solvent that becomes progressively richer in solute and the underflow stream is solute that is diluted with solvent to a progressively leaner concentration of solute.

On Fig. 2 the overflow stream is designated as O_0 , O_n , O_1 ; the underflow stream is L_s , L_n . Overflow compositions are y_s , y_s , y_s ; underflow compositions are x_s , x_n .

Construction of the graph shown in Fig. 3 hinges on location of the difference point, e. This in turn is a function of the composition, x, of the underflow phase.

Variation of this composition, Δx , is a function of the difference in mass of any particular component divided by the corresponding difference in total streams, at the particular station within the extractor. The resulting difference in mass

Method gives both number of stages and composition of fish oil



fraction is a coordinate of the difference point:

 $\Delta x = (L_{\bullet}x_{\bullet} - O_{1}y_{1})/(L_{\bullet} - O_{1}) =$ $\dots (L_n x_n - O_o Y_o) / (L_n - O_o) \quad (1)$

For the more general case where the ratio of the underflow and overflow rates varies throughout the column, a modified Ponchon and Savarit construction can be used, Fig. 3. Then, the operating lines will intersect at a common difference point on the composition coordinate as defined by Eq. (1).

In the construction of Fig. 3, two parallel composition lines are drawn at any convenient distance apart and the terminal composition points located thereon, i. e., x_0 , x_0 , y_0 and y_1 . A line is drawn to connect points x_a and y_a . The location of point eon the extension of line $x_n y_n$ is de-

fined by Eq. (1) or by:

 $ey_{\bullet}/ex_{\bullet} = L_{\bullet}/O_{\bullet}$

The over-all component balance is completed by joining e to x, and erecting a vertical line through y. to intersect the straight line ex. at y_i . This location of y_i also is defined such that

 $ey_1'/ex_* = L_*/O_1$

If the solute diffuses completely from the solid to the solvent in the first stage, i. e., the solid is nonselective, the separation factor can be taken as unity. Consequently, a vertical line can be drawn through yi' to intersect the underflow composition line x at x_i . The operating line for the streams L_1 and O_2 leaving and entering the first stage is given by joining ex_1 .

If experiment indicates that the separation factor is not unity, then $x_i y_i'$ is given the appropriate slope to correspond to the factor.

The volume of the underflow stream L, entering the column often alters considerably because the amount of underflow adhering to the entering solid is not saturated with regard to the overflow stream leaving the column. Thus, while solute diffuses from the underflow to the overflow stream, solvent cross-flows to increase the volume of underflow adhering to the solid.

As the construction in Fig. 3 applies only to saturated flow rates, it is necessary to calculate L_1 and O_2 arithmetically and use the ratios of these flow rates to locate yo' on ex.

All other operating and equilibrium lines (unity in Fig. 3) intersect on the varying reflux line, y.y.'. Consequently, a zig-zag construction can be used to evaluate the number of stages. Compositions on the line y.y.' are the same as the compositions of overflow located below on the y composition line.

For the simple case where the ratio of underflow to overflow is constant, the operating and equilibrium lines all intersect on the overflow composition line, y, of Fig. 3.

Two examples have been selected to show the accuracy of this graphical method of calculation. In both examples, the equilibrium ratio is unity and the reflux ratio varies throughout the column.

Extract Oil From Meal

Oil is to be extracted from meal by a continuous countercurrent extractor. The unit is to treat 2,000 lb. of meal per hr., based on oilfree solids. Untreated meal contains 800 lb. of oil and 50 lb. of benzene. Fresh wash consists of 20 lb. of oil dissolved in 1,310 lb. per. hr. of benzene. Exhausted solids will contain 120 lb. of untreated oil. How many stages are required for this degree of extraction?

Over-all Material Balance - A material balance on a solid-free

Nomenclature

- 0 Quantity of solvent or overflow
- phase, lb. per hr. Quantity of extractable or underflow phase on a solids-free basis, lb. per hr. Composition of overflow phase. Composition of underflow
- phase. point of intersection of the op-
- point of intersection of the op-erating lines. Subscripts O, I, 2, n I, n, refer to streams and composi-tions entering the column and entering and leaving the re-spective ideal stages.

basis is summarized on Fig 4. Flow rates and compositions of the entering streams, as stated in the problem above, are : O., 1,330; y., 1.5; L., 850; x., 94.1.

The composition of the entering overflow stream, $y_* = 1.5$, is used to obtain approximate values of x. and La. These, in turn, are used to arrive at corrected values of x. and L.

From data in Badger and Mc-Cabe⁶ solid meal will retain 0.5025 lb. of 1.5% solution per lb. of solid. Thus, the total amount of underflow stream L_n is $0.5025 \times 2,000 =$ 1,005 lb. The composition x_n is 120/ 1,005 = 11.94% oil.

Referring once again to Badger and McCabe, we find meal leaving the column will retain 0.507 lb. of 11.94% solution per lb. of solid. Corrected values of L, and x, are now obtained: $L_n = 0.507 \times 2,000$ 1,014 lb.; $x_n = 120/1,014 =$ 11.83% oil.

An over-all material balance over the column for each component gives: $O_1 = 1,166$ lb.; $y_1 = 60.0\%$ oil.

Determination of L, and O,-For a concentration of 60.0% oil in the exit solvent stream, O1, the amount of solution that is retained by the solid, is 0.595 lb. per lb. of solid. Therefore, $L_1 = 0.595 \times 2,000 =$ 1,190 lb. By a material balance over the first stage, $O_i = O_i + L_i - L_o =$ 1,166 + 1,190 - 850 = 1,506 lb.

Number of Stages-The over-all compositions x., 94.1; x., 11.83; y., 1.5; y, 60.0 are located on the underflow, x, and overflow, y, composition lines, as shown in Fig. 5.

The terminal compositions x_a 11.83; and y., 1.5 are joined and extrapolated to e, which is located by Eq. (1) or by reflux ratio: $ey_{\circ}/(ex_{\circ}-ey_{\circ})=L_{\circ}/(O_{\circ}-L_{\circ})=$ 1,014/(1,330 - 1,014) = 1,014/316

Next, join e and x, and divide at y,' such that:

 $ey_1'/(ex_* - ey_1') = L_*/(O_1 - L_*) =$ 850/(1,166 - 850) = 850/316 =

Now, join y_1' to x_1 by a vertical line since the separation factor is unity. Then, further join x_i to eand divide at y's such that:

 $ey_0'/(ex_1-ey_0)=L_1/(O_0-L_1)=$ 1,190/(1,506 - 1,190) = 1,190/316= 3.76

Join y,' to y, and then evaluate the remaining number of equilibrium stages by a zig-zag construction between the vertical equilib-

Retention Varies With Concentration

Lb. of Oil per Lb. of Sol'n	Lb. of Sol'n Retained per Lb. of Oil-Free Livers
0.00	0.205
0.10	0.242
0.20	0.286
0.30	0.339
0.40	0.405
0.50	0.489
0.60	0.600
0.65	0.672
0.70	0.765
0.72	0.810

rium lines and the operating lines. These lines intersect on the varying reflux line $y_0' - y_0$ with the operating lines also passing through the common difference point, e.

From Fig. 5, it can be seen that four theoretical stages are required. The results agree almost exactly with Badger and McCabe."

Recover Oil From Fish Livers

Oil is to be extracted from halibut livers with ethyl ether in a continuous countercurrent multiple-contact system."

Determine the number of stages required to recover 95.0% of the oil from 1,000 lb. of fresh livers containing 25.7% oil, when the overflow contains 70.0% oil. All compositions are expressed on a mass

The quantity of solution retained by the granulated livers varies with the composition of the solution. This was determined experimentally by Ravenscrofts and the results tabulated by Brown' as shown in the adjoining table.

Over-all Material Balance - In Fig. 6 is shown an over-all material balance of this process on a solidsfree basis.

The entering stream $L_{\bullet}=1{,}000 \times 0.257=257$ lb. of oil. The exit stream L_* contains $257 \times 0.05 =$ 12.85 lb. of oil.

Composition of the discharging solvent stream, $y_1 = 70.0\%$ oil. The amount of solvent stream discharging is, $O_1 = (257 - 12.85) \times 10/7$ = 349 lb. of solution.

Assuming the pure solvent entering is now leaving stage n, the amount of solution retained by $L_a = 0.205 \times (1,000 - 257) =$ 152.3 lb. of solution. The composition of the exit stream $x_a = 12.85/$ 152.3 = 8.4% oil.

Taking now the solvent concentration leaving stage n as 8.4% oil, the amount of solution retained by the discharging liver, $L_n = 0.23$ (1,000 - 257) = 170.9 lb. of solution.

The composition, x_n , of the exit stream is 12.85/170.9 = 7.5% oil. The entering stream of ether, O., is 170.9 + 349.0 - 257.0 = 262.9.

Determination of L, and O,-For a concentration of 70.0% oil in the exit solvent stream, the amount of solution retained by the solid is 0.76 lb. per lb. of solid. $L_1 = 0.765$ (1,000 (257.0) = 566 lb. of solution. $x_1 =$ 70.0% oil. $O_0 = 349.0 + 566.0$ -257.0 = 658 lb.

Number of Equilibrium Stages-On Fig. 7 the over-all compositions x_{\bullet} , 100; x_{\bullet} , 7.5; y_{\bullet} , 0.0; and y_{\bullet} , 70.0; are located as shown on the underflow, x, and overflow, y, composition lines.

The terminal compositions x_n , 7.5 and y., 0.0 are joined and extrapolated to e such that e is located by Eq. (1) or by reflux ratio:

 $ey_{\bullet}/(ex_n - ey_{\bullet}) = L_n/(O_{\bullet} - L_n) =$ 170.9/(262.9 - 170.9) = 170.9/92= 1.86

Next, join e to x, and divide at y_1' such that

 $ey_1'/(ex_{\bullet} - ey_1') = L_{\bullet}/(O_1 - L_{\bullet}) =$ 257/(349.0 - 257) = 257/92 = 2.8

Join y_1' to x_1 by a vertical line since in this problem the separation factor is unity and then further join x_1 to e and divide at y_2 such

 $ey_0'/(ex_1-ey_0')=L_1/(O_0-L_1)=$ 566/(658 - 566) = 566/92 = 6.15

Join y' and then determine the remaining number of equilibrium stages by the graphical construction shown.

Comparison of the results from Fig. 7 with those of Brown shows exact agreement, both in the number of ideal stages and in the composition of oil in each stage.

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= 3.2.

A New Process Tool:

Low-Finned Tubing

It's taking hold in high fluid-to-fin coefficient services outside the range of high-finned tubing.

B. Q. KERN, D. Q. Kern Associates, Cleveland, Ohio*

L OW-FINNED tubing represents a new and important extendedsurface heat transfer element for the process industries. Some highly-successful applications have already been made.

Until five years ago, there were two principal types of extended-surface heat transfer elements: (1) the transverse high-finned tube, and (2) the longitudinal high-finned tube. The transverse high-finned tube is used primarily in operations involving gas-to-fin heat transfer—while the longitudinal high-finned tube is used primarily in double-pipe exchangers for viscous fluids, in shell and tube exchangers for gases and viscous fluids, and in suction oil heaters.

Besides these, there were numerous types of spine and pegfinned tubes and a wide variety of discontinuous types of transverse finned tubes (such as stars and modified stars) which are no longer available commercially.

Area of Application

Low-finned tubing (having fins 1/18 or 1/2 in. high) has gained in shell and tube exchanger design—particularly in the high fluid-to-fin coefficient services considered outside the range of high-fin applications.

On the other hand, applicability of high-finned tubes (having fins in high and higher) is greatest where the heat transfer coefficient from the fluid to the fin is small. This is a natural deduction from the concept of fin efficiency.

The efficiency with which a fin attached to a tube will transmit the heat which it receives at its sides depends upon the maintenance of a temperature gradient between the tip of the fin and its base. The greater the heat transfer coefficient from the surrounding fluid to the sides of the fin, the more nearly the fin as a whole approaches the mean temperature of the surrounding fluid. Thus a reduction in the temperature gradient results within the fin metal from the tip to the base.

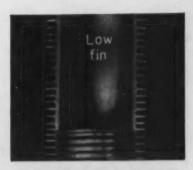
Efficiencies of finned tubing in their various commercial forms can be defined fairly well by straightforward mathematics. They depend upon the coefficient to the fin and the fin conductivity, height, perimeter and cross-sectional area.

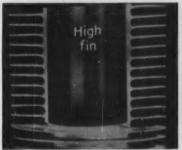
Fin efficiency alone does not take into account the cost of the fin metal, the attachment of the fins to the tubing, or the cost of the tubing. Where an extended-surface thermal element can be made cheaply, it is possible to find applications even where the coefficient is high and the fin efficiency is low. But so far these have escaped widespread application in the process industries.

Manufacture

Low-finned tubing may be made by wrapping narrow ribbons endwise and bonding the ribbons to the tube at the base of the fin. More commonly they are made by extrusion from the tube wall itself.

In the extrusion finning process, the starting point is bare tubing of say 1 in. O.D. \times 14 BWG. The tubing is rotated within an assembly of closely spaced, oblique, hard-alloy wheels which compress the metal inward from its O.D.—leaving continuous helical fins which correspond to the spaces between the wheels. Thus tubing can be extruded from the 1 in. O.D. \times 14 BWG bare tubing which will have 19 helical fins per inch $\frac{1}{16}$ in. high, and be approximately 1 in. O.D. The fins will be homogeneously a part of a "root" tubing





Courtesy Walnering Tube

whose dimensions become those of in. O.D. × 16 BWG tubing.

This tubing will have 260% of the surface of the bare tubing from which it was formed without the waste or addition of any material. The final cost is about 125% of the bare tubing. In the more expensive alloys, it is even less.

By leaving the ends of the tubing unfinned, it is possible to insert the tubing through the tube sheets and baffles of any shell-and-tube exchanger designed for 1 in. O.D. tubing. Low-finned tubing is available in all the common gages for heat exchanger and condenser tube layouts using tube outside diameters of \$\frac{1}{4}\$, \$\frac{3}{4}\$ and \$\frac{1}{2}\$ in.

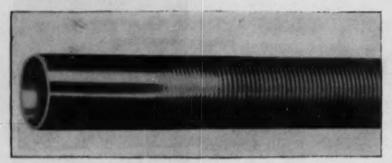
Performance

Commercial-scale test data under field operating conditions are difficult to obtain. Relatively few companies maintain test programs, particularly for equipment which exceeds specifications.

As a result the writer and associates undertook a systematic survey during the past year of the design and application of both high-finned and low-finned tubing for services incidental to the process industries.

A number of operating companies comprising the most extensive users of low-finned tubing were interviewed at their plant sites and a multiplicity of observations and reports resulted. Some of these may well affect heat transfer design and theory in the future.

[•] Meet your author on page 387.



UN-FINNED ENDS on low-finned tubing permit rolling into tube sheets.

Low-finned tubing first appeared commercially in condensation services in the refrigeration industry, and later in the petroleum industry where they were used to re-tube existing bundles so as to increase capacity without increasing the size or number of shells or their supporting structures. These bundles showed little tendency to foul on the fin side even when initial operating conditions appeared to tax their capacities.

Low-finned tubing was next used for retubing petroleum reboilers, where the clean performance sometimes exceeded that anticipated by the summation of the design resistances for finned tubing. Furthermore, fouling occurred at a reduced rate.

Soon low-finned tubing was used for sensible heat transfer on residues and other dirty materials. It had been surmised that low-finned tubing might be occluded by the dirt usually found in residues, but the performance record of retubed bundles has forced a revision of this opinion.

Mechanisms

It is helpful here to bring to light some of the theories which make the reported performances of low-finned tubing appear probable, and to open for further consideration the mechanisms wherein low-finned tubing is uniquely different from high-finned or bare tubing.

Fouling—Consider a fluid flowing outside a tube and having a given fouling factor over a definite period of service such as $R_{4171} = 0.002$ hr. \times sq. ft. \times °F/Btu.

Temperature drop through the dirt for bare tubing is given by:

 $Q = (1/R_{airt}) A \Delta t_{airt}$ where A is the outside surface of the bare tubing or

 $\Delta t_{dirt} = R_{dirt} (Q/A)$ and for finned tubing $\Delta t_{dirt} = R_{dirt} (Q/A_t)$

where A_i is the gross outside surface for the finned tubing. Terms Q/A and Q/A_i are identified as the heat fluxes.

Fins are used because a square foot of fin surface is cheaper than a square foot of bare tube surface. Low-finned tubing surface costs about half as much as bare tube surface. It is also seen that provision for the dirt factor is made by allowing specific extra surface beyond the minimum requirement computed for the clean overall coefficient

This extra surface—and even more—can be provided by low-finned tubing without dissipating the advantage of lower first cost. Any increase in surface through the use of finned tubing correspondingly decreases both the heat flux and the temperature difference through the dirt. Hence it increases service life of the equipment before it requires cleaning.

In cases of re-tubed bundles employed for the same duty as before with bare tubing, the shell side heat flux will be reduced to approximately two-fifths its former value. Service life will be correspondingly increased two-and-a-half-fold on the shell side.

This assumes, of course, uniform rate of scale formation. It is true even though the controlling resistance is on the tube side and probably accounts for the long service periods reported by users. It also means that in any shell-and-tube exchanger the requirement for cleaning the shell side, which is generally the more difficult of the two, can be omitted on some turnarounds.

Varying Fin Efficiency — Highfins have been precluded from general acceptance in shell-and-tube exchangers because in many instances the heat transfer coefficient on the shell side is quite high. When the coefficient is high, the fin efficiency of high-fins is generally below the range of economic return.

The higher range of fin efficiency in low-finned tubing encourages its use with high coefficients. Furthermore, the greater the fouling factor on the shell side, the greater the opportunity to effect design economies at higher coefficients.

The fin efficiency is predicated on a number of factors, as stated earlier, and among these is the heat transfer coefficient to the fin. The lower the heat transfer coefficient, the higher the efficiency. When the fin surface is clean, the coefficient is entirely effective at the fin. When dirt starts to deposit, value of the coefficient arriving at the fin is reduced by the resistance of the dirt film which has formed. Fin efficiency is thereby increased.

Thus we can readily attain a condition with high heat transfer coefficients where the deposition of dirt is offset in part by the increase in efficiency. Doubtless this relationship explains some of the instances in which bundles have operated for long periods without apparent decrease in overall coefficient, only to appear fouled on visual inspection.

Fin Occlusion — Certain fluids deposit a rather hard scale. This is particularly true in the case of light ends and re-distilled materials such as occur on the debutanizer and depentanizer columns of mod-

ern refineries.

With bare tubing, there is a tendency to form an insulating cylinder of scale about large portions of the bare tubing.

On low-finned tubing, there is a tendency for the hard scale to flake in a plate-like form as though the fins served as knife edges. These plates may remain on the tube parallel to, but not entirely bonded to the fins. Their presence does not materially decrease heat transfer to the fins. They are frequently self shedding due to expansions and contractions of the tube during normal operation.

Some fluids, particularly viscous ones, deposit large quantities of a dense material which might suggest the possibility of fin occlusionsince the fins under discussion are usually only about 1/16 in, high.

Suppose a material deposited a film 1/16 in. high, and the material had the relatively low conductivity of only 0.10 Btu./hr. × sq. ft. × °F./ft. Resistance of the resulting film would be 0.05 hr. × sq. ft. × °F./Btu., which is roughly five to ten times as great as the maximum dirt factor generally allowed for maintained equipment.

Furthermore, with clearances of only 3/16 to 1 in. employed between tubes in general exchanger design, it is likely that a fluid pumping problem would arise well ahead of an appreciable reduction in thermal performance.

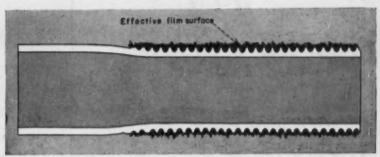
There appears to be no support of the image that dirt will accumulate preferentially between the fins and thus block availability of the fin surface. Scale formation, even in a dirty service, is a relatively slow process during which the bonding particles follow the contour of the fins and form an extended projection of them.

Even in the case of slurries and slimes, there is no report of serious loss of fin effectiveness through occlusion. A boundary layer of slime may form about a tube in a severe case—which is nevertheless controlled by the contour of the fin, since a turbulent layer at the outside of the dirt provides the compensating surface over the film of dirt. With reduced heat flux, the layer must be several times as great as on a bare tube to produce an equivalent resistance to flow.

Condensation—In Nusselt's derivation, it is assumed that the principal resistance to condensation is that of conduction through a film of condensate. Whatever circumstance decreases the thickness of the film, such as decreased tube loading, will also increase the value of the condensing coefficient accordingly.

For an organic compound having a condensing coefficient of 250 Btu./hr. × sq. ft. × °F., and a condensate thermal conductivity of 0.10 Btu./hr. × sq. ft. × °F./ft., the average film thickness in filmwise condensation is about 0.005 in.

Height of the fin on low-finned tubing having the dimensions of Wolverine Trufin is about 12 times greater. It does not seem probable, then, that the presence of the fins should improve the value of the condensing coefficient. This is borne



CONTINUITY of heat transfer surface is maintained with soft fouling deposits.

out on experimentation with a single tube.

In the case of tube bundles, however, the situation is somewhat different. Here it is well known that the mean coefficient for all of the tubes in the bundle is less than that for a single tube under identical conditions of loading. This is attributed to the drips from the upper tubes, which increase the apparent thickness of the condensate layer on the lower tubes. When it is considered that a commercial condenser can easily have from 10 to 100 rows of tubes one-above-theother, the lower tubes may be fairly-well inundated and ineffec-

It is here that the knife-edge characteristic of low-finned tubing again appears to manifest itself. By cutting through the cumulative layer of drips and condensate, the lower edges of the fins serve as drainage points which reduce the height of film on the lower tubes. Visual studies have confirmed this.

Thus, in very large bundles, it is possible for field tests to indicate that all of the surface on the shell side of a condenser is completely effective without the apparent reduction in heat transfer incidental to fin efficiency.

Vaporization — Present interest in vaporization centers about horizontal thermosyphon reboilers and kettle-type reboilers. These are frequently dirty services, as mentioned previously, and are accompanied by high shell side coefficients.

In addition to the natural advantages of low-finned tubing for large dirt and high coefficient services, it was observed almost ten years ago that experimental coefficients were obtained which were over 80% of those observed for bare tubing per sq. ft. of gross

outside surface. Field tests appear even more favorable and there appears to be physical justification.

Heat transfer by vaporization is closely allied with the convection currents which are set up in the vaporizer. Outside surface of the bare tube portion of the finned tubes will naturally be at a higher temperature than the tips of the fins.

It would appear that the greater environment for both convection heat transfer and ebullition is within the recesses of the tube. The contributory value of the fins would then appear to be less than that of the bare tube surface adjoining the bases of the fins, and the effectiveness of the gross surface would be somewhat less than 100% that of a bare tube.

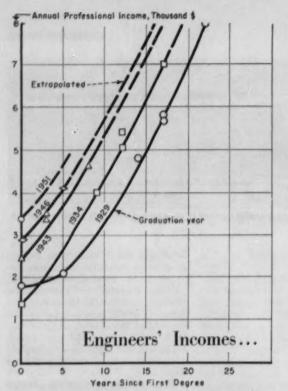
At least several possible explanations of higher rates exist. First, the compactness of low-finned tube surface compared with bare tube surface is such that the over-all convective currents may be greatly amplified beyond their values with bare tubes per foot of length.

Second, the relatively sharp fins—jutting out into the fluid body—may serve selectively for the formation of bubbles away from the root surface of low-finned tubing. At least they may serve to lead bubbles formed at the bare surface away from it.

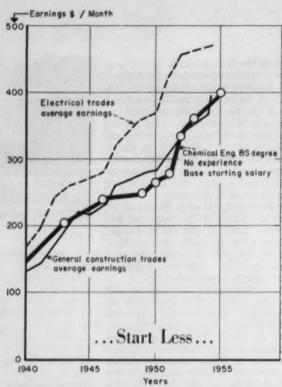
Explanation of the high reported rates, however, may very well lie in a combination of both effects. To date there have been no reports of lower flux limitations necessary in the application of low-finned tubing for boiling services.

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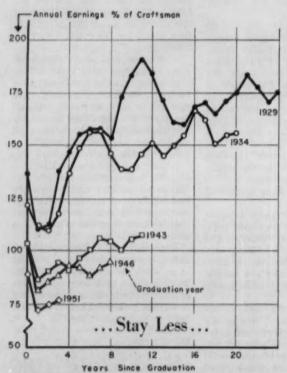
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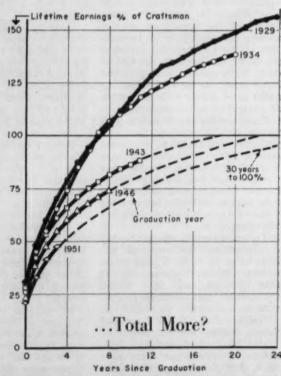
Chemical engineering graduates are getting more, but annual incomes increase at a constant rate.



Despite periods of shortage or oversupply, starting salaries faithfully parallel the trades.



Annual earnings of the most recent graduating classes surveyed fall below skilled craftsmen.



It's taking longer to reach the point where total earnings equal those of the craftsman.

Does Chemical Engineering Pay?

Compiled statistics shatter the popular myth that engineers are becoming an economic elite. Financially they do little better than brick-layers.

This isn't encouraging news in these days of engineering shortage.

PAUL B. STEWART, University of California, Berkeley, Calif.*

It will take the median engineer, graduated in 1951, better than 30 years to accumulate a total income equal to that of a skilled craftsman. Only then will he begin to recoup the cost of his education. The 1929 graduate reached an equivalent income level in less than a quarter of that time.

In the chemical and petroleum industries, standard payout time for a good investment is considered to be in the range from three to five years.

And further, despite all the hue and cry about an engineering shortage, chemical engineers' salaries faithfully tag after the general wage pattern. There's no indication that the law of scarce supply and great demand is working for the chemical engineer.

In the harsh, and perhaps startling, light of these facts, revealed in the graphs to the left, can we say that a chemical engineering education pays?

Some Don't Think So

Apparently many high school graduates don't think so. With no special education and no experience they can take jobs in grocery stores and service stations that pay from \$320 to \$350 per month. University of California engineering graduates of June 1955 (BS degree, no experience) most frequently reported starting salaries in the neighborhood of \$400 per month.

Many high school graduates prefer to bypass a college education with its higher starting salaries in favor of jobs directly available after high school.

Earnings Rate as a Key Factor

One basis of comparing a means of earning a living against any other is the financial return of each, This admittedly does not tell the whole story. It neglects, for example, so-called fringe benefits and still more intangible factors such as personal satisfaction, prestige and the opportunity for advancement. But a gross income comparison, as set forth in the graphs, represents a quantitative measure, and certainly is of, at least, some importance to all people. It is a primary consideration when young people choose an occupation.

It is quite likely that a large number of high school graduates who have the aptitude for engineering would elect one of the skilled trades if they decided to terminate their formal education with high school graduation. That is the basis of this evaluation. It compares the earnings of an average craftsman with that of a median engineer, both of whom finished their secondary education at the same time.

Why Pick the Building Trades?

The building trades represent the skilled craft. They were selected mainly because complete data was available.

Often the cry is raised in a comparison between technical and craft earnings, particularly in the case of the building trades, that the trades don't promise continuity of employment. Undoubtedly true in some areas, it is less true in parts of the country, such as California, where the weather permits year-round construction. And the same lack of continuity marks the fate of many engineers; in construction work and certain other industries.

A comparison of the wage rates for the petroleum refinery trades and the union wage scales for the building trades demonstrates that people of the same competence make very nearly the same amount in both industries, Similar comparisons between the printing trades

and machine shop trades indicate the same results. Thus it appears that building wage rates are a fair measure of craft earnings in general, both for occupations with good and questionable continuity of employment.

Why Pick the Median?

This study concerns the earnings of the median chemical engineer and the average craftsman. It would be fair to ask then, what about the non-median engineer? (And for that matter, what about the non-average craftsman?) Statistics of the type used in this analysis obviously cannot answer these questions. A few comments, however, are in order.

One advantage of using figures for median engineers, from the very definition of the median, is that there are just as many individuals below it as above it. However, data collected by the American Institute of Chemical Engineers in its 1952 survey indicate that the difference between the lower 25 percentile and the median is less than that between the upper 25 percentile and median. Spread of salaries for engineers in the upper half of the earnings bracket is much greater than it is in the lower half. Thus more engineers do much better than the median than do equally poorly.

But the calculations in this report assume, in the case of the craftsman, that "once a journeyman always a journeyman." This obviously neglects those individuals who leave the journeyman status to become supervisors, contractors, etc. So, a treatment of this kind may well be just as unfair to, and misrepresentative of the exceptional craftsman as it is to the upper 10 percentile of engineers.

Most of the earnings data used come from publications of the Bureau of Labor Statistics, U. S. De-

^{*} Meet your author on page 388

partment of Labor. These are supplemented by data from other sources where consistent with those of the Bureau.

Fig. 1 traces the steady increase in annual income of the median chemical engineer during the years following his first degree. Parameter for the five curves is year of college graduation. Presented in this way they promise handsome salaries for the graduating classes of the future. But they tell only a part of the true tale.

Since all the curves in this plot are approximately parallel they have been extrapolated on that basis where required. Surveys of the Bureau of Labor Statistics in 1929, 1934, 1943, 1946, and 1951 provide the earning information used. Except for the year 1951 results the earnings data are given as functions of years of experience. The 1951 data, given as functions

What Others Say

Despite reports that professional people are in short supply . . . median pay for engineers are about the same as those of production foremen.

> American Management Association, Personnel, Sept. 1955, p.

Technology progresses when there are sufficient incentives . . . technology requires personal incentives for the scientists.

Henry du Pont to the Kinston (N. C.) Chamber of Commerce.

What tangible incentive is there for a boy to be an engineer under an economic system which 35 years after their graduation provides the average plasterer with greater accumulated earnings than those of the average civil engineer.

Lt. Gen. L. R. Groves, to Military-Industrial Conference, Chicago, 1955.

Russian scientists and engineers . . . are much better paid in proportion to labor than scientists and engineers here.

> J. R. Dunning, Dean, Columbia School of Engineering to MCA (1955).

of age, have been converted by assuming graduation at the age of 22. American Chemical Society data are consistent with these figures.

Repealing Supply-Demand Law

In Fig. 2 the true economic position of the engineer develops. This figure is a plot of average earnings in the general building and electrical trades and of starting engineers salaries during the

past two decades.

Very close correspondence of the curves is indeed striking. It seems to indicate that supply and demand has little, if any, effect on engineering starting salaries. Rather they seem to be tied to other wage scales. For example, the curves agree just as well in the 1930's and in 1950 when there was an over-supply of engineering graduates as they do during the years of World War II and the Korean affair and since, when employers were (and are) bemoaning the lack of technical manpower.

Higher level of the electrical trade curve is probably accounted for by the higher percentage of journeyman or the lower percentage of unskilled labor in that trade. Earnings data for this plot were gathered from the BLS reports of

1907 to 1954.

Telling the Full Tale

Figs. 3 and 4 complete the story of the engineers economic position. They make it quite clear that during the engineer's professional life he earns relatively little more than the skilled craftsman.

These two graphs compare the median earnings of the chemical engineering classes of 1929, 1934, 1943, 1946 and 1951 with those of the craftsman who finished high school the same year as the engineer. In plotting these curves it was assumed:

· All graduates started to work at the beginning rather than in the middle of the year.

· All engineering graduates obtained their bachelor's degree four years after finishing high school.

· Engineers' annual earnings are 12 times the monthly figures reported.

· Craftsman spends his first two years as a laborer at 80% of the general average; his next three years as a helper at the average and his subsequent years are journeyman years at 120% of the average of the general building trades.

· Craftsman's annual earnings are considered as 50 times the

weekly figures reported.

Fig. 3 shows a year by year comparison of the median annual earnings of the five college chemical engineering classes as a function of years since graduation. Engineers' earnings appear on the ordinate as percent of the craftsman's wage rather than dollars. This reduces the effect of inflation and enables direct comparison of the relative economic status of the two groups. The graph traces the marked decline during the 22 year period of the chemical engineer's relative economic status. The minimum in all the curves at the first year results from the assumed elevation of the craftsman to journeyman status at that time.

How Long to Recoup?

Fig. 4 presents the same data, expressed in the same way, except that lifetime earnings replace annual earnings as the criterion. It shows how many years each median engineer must spend in his profession before he will finally accumulate as much total earnings as skilled craftsmen.

Classes of 1929 and 1934 achieved this income level in seven years. Other classes still have not reached this equality. Extrapolation of the curves indicates the following approximate "break-even point" for the other classes: 1943, 19 years; 1946, 26 years; 1951, more than 30 years. Assuming the present trends continue, the class of '56 can be seen to be in a still more unfavorable economic position.

As, at least, a financial investment a chemical engineering education for the high school student who can be expected to become a median engineer does not seem to pay. Its pay out period is six times or more longer than that which industry considers a sound venture.

Yet, financial gain is not the final measure of whether chemical engineering pays. Opportunity for advancement, for example, is high. As Business Week pointed out recently, more top executives are engineers. It is hoped that the neophyte chooses the profession for its other, more favorable, aspects.



Put Color to Work in Your Plant

Here is, how to use color functionally in your chemical plant for coding equipment and painting work areas. Proper use of color will ease training problems, reduce accidents and operating errors.

D. E. GARRETT and W. A. JORDAN, American Potash & Chemical Corp., Trona, Calif.*

The chemical industry today has at its disposal an effective tool for promoting the safety and efficiency of its employees—functional use of color.

By marking pipes and equipment with color signals to indicate hazards, accidents can be materially reduced. When this color coding extends throughout the plant, it permits ready identification of all lines and equipment, greatly simplifying job training. Costly errors are lessened, and the appearance of the plant inevitably improves.

Another important function of color is in the painting of work areas for the greater comfort and efficiency of the employee. In many cases eyestrain and its resultant fatigue can be alleviated by a simple change in the color of a wall or machine. Such an improvement

pays off in increased productivity.

These advantages and others can be obtained for little more than the cost of routine painting. There are two general aids that have been found valuable in setting up a color system in a chemical plant: color codes and the basic principles of functional decoration.

Color Coding

Identification of piping and equipment by color is a practice of long standing with the chemical industry, although it has not become widespread until fairly recently. As a formal system, color coding was first suggested in 1909 when the Association of Edison Illuminating Companies published a report on "Standard Colors for Power Station Piping." Since that time the number of color codes developed by

different companies or groups has steadily increased.

In an effort to establish a uniform and more comprehensive system, the American Standards Assoc. in 1922 formed a committee on the identification of piping systems. Under the joint sponsorship of the National Safety Council and the American Society of Mechanical Engineers, this committee did an excellent job. Its scheme' is now the standard for color coding systems in the United States.

The ASA recommends five basic color groups:

- · F, fire protection-red
- D, dangerous materials—yellow or orange
- S, safe materials—green or the achromatic colors, white, black, grey or aluminum
- P, protective materials bright blue

^{*} Meet your authors on page 389.

Comparison of Piping Identification Color Schemes—Table 1

Material	A5A Classification	Motors	Du Pont	Monsanto	Cyanomid	Union Oil	ash & Chemical (Proposed)
Steam, high pressure	Dangerous— yellow or orange	Aluminum	Alert orange	Yellow, 2 black stripes	Orange	Aluminum, yellow band	Orange, 1 black stripe
Steam, low pressure	Safe below 212 F—green	Aluminum	Alert	Yellow, 1 black stripe	(Safe below 130 F.)	Aluminum, yellow band	Orange, 2 black stripes
Gas (fuel)	Dangerous— yellow or orange	Yellow	Yellow	Yellow band	Yellow	Yellow	Light orange
Dangerous process fluids (acids, etc.)	Dangerous— yellow or orange	Orange	Yellow	Yellow	Yellow	Orange	Yellow
Fresh water	Safe—cold Dangerous—hot Green	Green	Green	Green	Green (yellow stripes above 130 F.)	White (yellow band when hot)	Green (yellow stripe above 140 F.)
Brackish water	Safe—green	Green	Green	Green, 1 blue band	Green	White; black or brown band	Green, 1 black stripe
Compressed air	Safe to 300 psig. —green or achromatic	Blue	Yellow	Green, 1 orange band	Green (yellow stripes above 75 psig.)	Blue (white on low pressure)	Grey, (yellow stripe above 50 psig.)
Vacuum	Safe—green or achromatic	None	Grey	Green, 1 white band	None	Green	Grey, 1 orange stripe
Sprinkler (water) and fire equipment	Fire protection Red	Red	Red	Red	Red	Red	Red
Electric conduit	None	Black	Black	Orange	None	None	None

A stripe is generally less than 1 1/2 in. in width, while a band is wider, e.g., Union Oil Co.'s 1st color is three pipe diameters wide, while the band is one diameter wide, centered in the first color.

. V, extra valuable materialsdeep purple*

The classifications were purposely made broad, and the number few, to permit easy recognition for maximum safety and effectiveness. Colors were chosen for easy distinguishability. Red has histori-cally been used for fire protection equipment and its intense color permits rapid location of such equipment in a plant.

Yellow and orange are especially effective for marking hazards. They have the highest reflectivity of all the chromatic colors and can be most easily recognized under conditions of poor visibility.

Bright blue is a good color for focusing attention, and effectively sounds the precaution warning, while green designates safety.

Piping Code

The ASA scheme provides a general method for identification. It can be applied broadly and it has

*Purple, the fifth color group, has been officially reserved since 1953 for the designation of radiation hazards, and is no longer recommended by the ASA for extra valuable materials. Revisions of the ASA A12-1928 system will undoubtedly delete this color from the basic group in order that it may be used as a radiation color alone.

very little conflict with previous methods

In the case of piping it permits the use of recommended colors in bands, or as a complete coating for the length of the pipe. If bands are used they should be placed near all valves, junctions, or other critical points along the line. They should also be spaced at uniform intervals along straight sections of pipe.

By using suitable stripes on the bands, or on the continuously painted pipe, identification can be made of many different fluids or lines as required. Whenever it's desirable the name of the fluid can be stenciled on the band.

The ASA scheme is a sound basic classification method any individual user can adapt to his own needs and facilities. A company that is considering the system may decide to completely paint its piping, or simply to band lines for reasons of economy. The continuous colors are undoubtedly more effective but their expense is naturally greater.

On the other hand, self-adhesive plastic tapes have made banding easy and economical to install and maintain. Often some lines are banded and others completely colored (pipes that require paint

for corrosion resistance or are isolated and easy to paint). The mixture of two types of identification has been very successful.

Each company must decide on the extent of subdivision, or the number of fluids to be included in the color code system.

As Table I indicates, some variation is to be found among the major chemical and petroleum firms on this point, particularly where specific problems are created by special products. However, simplicity and clarity usually require that the number of coded materials be limited. In addition, the name of each fluid, or an abbreviation is often stenciled on the bands together with a direction-of-flow arrow, so that a particular material is easily identified even with a restricted number of code colors or striping designations.

Table II lists the average recommended stencil size for the identification lettering on various pipe sizes. A variety of letter sizes makes for better legibility and more uniform proportioning, but requires a larger inventory of stencils and complicates the job somewhat.

The choice of colors for piping is seen, in Table I, to vary considerably among the companies listed. The only major difference, however, is in the color used to represent steam. Most companies assign an individual code color to steam—sometimes yellow, more often orange.

A second point of some divergence relates to the classification of compressed air. The ASA lists it as a safe material, while at least part of the chemical industry considers it hazardous. The addition of a yellow stripe on the "safe" color band for pressures above 50 to 75 psig. (and, incidentally, for liquids above 130 or 140F.), as practiced by American Cyanamid, would appear to be sound.

Thus the color choice within the four (new) ASA groups is left somewhat to the user's discretion. All process piping should be first classified according to its fluid content as safe, hazardous, protective, etc. Then, considering the total number of materials handled, a decision can be made as to the number of code markings required. If only a few materials are handled it's not unusual to vary the colors and stripes coding each material. For a large number of materials, it's more practical to adopt a limited number of specific codes. You can rely on the legends printed on the bands to separate a given material from its general class.

Apparatus and Equipment

Table III lists the standard color coding for apparatus and equipment as suggested in the American Standards Association's scheme.*

Yellow, or yellow and black, is recommended for the "strike against" hazards such as low clearance, industrial trucks, or guard rails. Orange is standard for hazards likely to cause serious injury-hazardous rotating parts or safety starting buttons are often painted this color. Blue is used as a precaution color on electrical controls, while red naturally denotes fire equipment. Grey (or white or black) is often used for traffic marks and waste receptacles. Purple has gained acceptance for designating radiation hazards.

All of these colors fit within the basic ASA code, and if used consistently, and without exception they soon come to be recognized and accepted.

Improved safety records in

plants using color codes are numerous. A yearly frequency rate of 46 for certain accidents was reduced to 5.6 during the first year of color coding at a U.S. Army Quartermaster Corps installation. At a second depot, disabling injuries were reduced from 13.3 to 7.0 for each million man hours worked. The N.Y.C. Board of Transportation reported a 42% reduction in the accident rate after adopting a color coding system and carrying on an active safety campaign. While these figures are not likely to be duplicated in the already safety-conscious chemical industry, they do graphically illustrate the effectiveness of color code systems, combined with a safety program.

Color for Work Areas

The selection of plant colors, including those on structural steel and machinery, should be made on an orderly, predetermined basis. Correct selection of colors for specific locations and their integration with related areas can go a long way toward reducing worker fatigue, minimizing accidents, and providing pleasant working conditions.

Furthermore, the standardization of specific colors for certain uses minimizes paint inventories and generally helps to improve the appearance of a plant. Using a uniform color for painting structural steel is a good example. Terra cotta red or olive green are often used most effectively for this purpose, although any color can be used that does not violate the color coding system or interfere with the overall color scheme of the plant.

A uniform color specification for motors, gear reducers, pumps, etc., is also a step in the right direction. Usually a neutral color such as bluegrey or light-grey works best.

Reducing Fatigue

Control of brightness, light intensity and glare are important considerations in selecting colors for work areas. The eye tends to adjust itself for light intensity, but repeated or too frequent adjustment can lead to eye-strain, fatigue or headaches. Thus the eyes of a man working at a dark machine facing a window or a light-colored wall have to adjust each time he glances up. Research has shown that the "brightness ratio" in such a case should not exceed 10 to 1, or better yet 5 to 1. This ratio is a measure of the relative amount of light reflected from two surfaces: if the wall reflects 50% of the light striking the area, while the machine reflects 25%, the brightness ratio is 2 to 1.

To correct a poor ratio, a wall can be painted a darker shade or

Size of Stencil Letters-Table II

Outside Diameter of Pipe or		Letter Size, in.	American Potash
Covering	ASA	Du Pont*	& Chemical!
3/4	1/2	1/2	5/8
1	1/2	5/8	5/8
1 1/4	1/2	3/4	5/8
1 1/2	3/4	3/4	5/8
2	3/4	3/4	1
2 1/2	1 1/4	3/4 or 1 5/16†	1
3	1 1/4	3/4 or 1 5/16	1
3 1/2	1 1/4	3/4 or 1 5/16	1 1/2
4	1 1/4	3/4 or 1 5/16	1 1/2
4 1/2	1 1/4	3/4 or 1 5/16	1 1/2
5	1 1/4	3/4 or 1 5/16	1 1/2
6	1 1/4	3/4, 1 5/16 or 2 7/16†	2
7		3/4, 1 5/16 or 2 7/16	2
8	2 1/2	3/4, 1 5/16 or 2 7/16	2 1/2
9	2 1/2	3/4, 1 5/16 or 2 7/16	2 1/2
10	2 1/2	3/4, 1 5/16 or 2 7/16	3
11	3 1/2	3/4, 1 5/16 or 2 7/16	3
12	3 1/2	3/4, 1 5/16 or 2 7/16	3
13 and over	3 1/2	3/4, 1 5/16 or 2 7/16	4

* For plastic bands only.

† Letter size dependent upon band width and number of letters and spaces.

Proposed.

a shield placed in front of an offending window. But it is preferable to paint the machine a lighter color. Since the eye tends to concentrate on the lighter or brighter area, painting the machine will improve safety and operating efficiency. The Public Building Administration was able to report a 5.5% increase in worker efficiency in a single office by reducing high brightness ratios to less than 5 to 1.

Another proven method for reducing eyestrain is the use of complementary colors on the walls behind machines or other objects of focus-coral behind blue-green, for example. The eye is actually rested by the change from a color to its complement.

Total illumination is very important and the use of light, highly reflective colors whenever possible is a major requirement of functional coloration in working areas. By

using reflective colors in keeping with allowable brightness ratios, the lighting becomes more efficient, and visibility and productivity increase. Studies have shown that the most restful lighting is from large area, low intensity sources. Good room reflectivity aids considerably in approaching this condition. Table IV lists the preferred range of reflectivity for the walls, ceiling and floor of a room.

Other Effects of Color

The associated effects of certain colors are well known: for areas in which the temperature is too warm, the use of light-green or blue-green walls is found to have a cooling result on the occupant, while in cold areas, warm tones have the same ameliorating effect. Cool colors also give a receding appearance to walls and tend to make a room seem

Preferred Reflectivity-Table IV

Room I	Eles	ne	m	t															1	Rei	flectivity
Ceiling					*	*	*			*	*	*	*				*				80-85%
Window	WW	7a.	Ha	1									0	0				o	0	6	75-80%
Upper	wa	lls		×	,									*	*			*	×		80-85%
Walls									×	*	*	,	,							8	50-60%
Walls	(wl	ne	n	6	n	ŧ	ĺĮ	16	1	8	0	10	E	n		m	10	26	et	.85	
recor	nm	en	di	at	1	01	n)									0				60-70%
Trim			6 6	*					è	×	×	,	8			,	÷	×	×	je.	30-40%
Floor																					15-30%

larger, while warm-colored walls have the opposite tendency.

Varying the predominant color from area to area provides a stimulating environment. At the same time, care should be taken not to overdo strong colors, and on large surfaces these are generally greyed.

It's not always easy to apply all these principles in a chemical plant. Tank colors, for instance, are often fairly inflexible, particularly in petroleum refineries where a minimum heat absorption is mandatory. When there is a choice, however, the overall color scheme of the plant, together with the glare or dark area created and the effect of the tank color as a background for machinery or instruments should be considered. In this connection, remember that strong colors are unpleasant on objects as large as tanks harsh or drab shades such as orange, dark brown and black should be avoided.

The cost of color coding and functional painting systems need not be a deterrent. Thoughtful planning and careful coordination of effort will often produce the desired effect for about the same expense as maintenance painting.

It is not unreasonable to predict that color coding will soon be standard practice in the chemical industry. Its advantages are manifest in the minimizing of errors as well as in better operating efficiency and improved appearance.

Identifying Apparatus and Equipment-Table III-

Fire exit signs, alarm boxes, blanket boxes, buckets or pails, extinguishers, hose and extinguisher locations, hydrants (industrial), pumps, indicator valves for sprinkler systems. Safety cans or other portable con-

tainers of flammable liquids. Red lights at barricades, or tem-

porary obstructions. Danger signs.

Emergency stop bars and stop buttons.

Orange

Safety starting buttons.

Inside movable guards, transmission guards for gears, pulleys, shafts, chains, etc.

Exposed parts (edges only) of shafts, pulleys, gears, rollers, cutting devices, power jaws, etc.

Yellow*

Corner markers for storage piles. Coverings or guards for guy

Exposed and unguarded edges of platforms, pits, and walls. Suspended fixtures which extend

into normal operating areas. Handrails, guardrails or top and bottom stairway treads.

Industrial locomotives (or areas). Lower pulley blocks and cranes. Markings for projections, door-ways, traveling conveyors, low beams and pipes.

*Painting, or plastic bands and sheets, with alternate black and yellow stripes should be used for hazard markings on flat surfaces and pipes.

Materials handling equipment (or areas thereon) such as industrial tractors, trucks, trailers, fork-lifts, conveyors, gantry cranes, etc.

Pillers, posts and columns. Stripe along sides of freight carloading plates or runways. Caution signs.

Green

Safety bulletin boards.

Gas masks, first aid kits, first aid dispensary, stretchers, deluge showers.

Painted barriers or flags at the starting point or power source of: elevators, ovens and vats, tanks, kilns, boilers, electrical controls, dryers, valves, scaf-folding, ladders.

Purple

Radioactive areas; handling and processing equipment.

Black and White

Traffic markings, solid or alternate lines: dead ends of aisles or passageways; location and width of aisleways; stairways (riser, direction and border limit lines); directional signals.

Housekeeping markings: location of refuse cans; white corners for rooms or passageways; drinking fountains and food dispensing equipment locations; clear floor areas around first aid, fire fighting or other emergency equipment.

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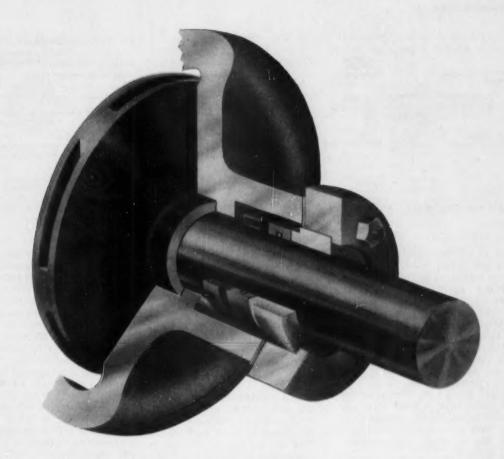
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MECHANICAL

SEALS

For Handling Abrasive Liquids

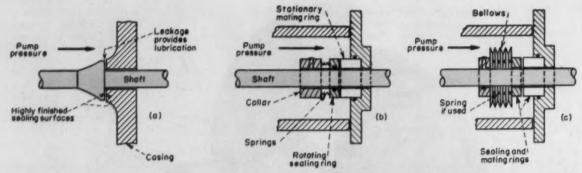
ROBERT D. NORTON, Dean Bros. Pumps, Inc., New York*

NE of the most troublesome problems in the handling of process liquids with centrifugal pumps is the sealing of the rotating shaft when abrasive solids are present. Last year (Norton, Chem. Eng. Mar. 1955, p. 183-6) we considered 13 ways of attacking the problem in the case of packed pumps. However, use of mechanical seals is a newer method which potentially offers many advantages compared to conventional stuffing boxes. So far, these newer devices have gained very little acceptance for abrasive applications, but I believe that their

use should and will be widened tremendously. Properly applied, they should yield important dividends to process industry users.

Mechanical seals go back about 40 years, but their acceptance has been relatively slow. For use in general service on non-abrasive liquids they have now largely completed their apprenticeship, and their applications have become fairly well standardized. For example, very large numbers have been used with complete success on automobile cooling water pumps and on hot water circulators for home furnaces. For gas handling they are standard on many

^{*} Meet your author on p. 391.



Simple theoretical seal in (a) is modified as in (b) or (c) to give uniform contact and allow for shaft run-out. (Fig. 1)

types of refrigeration compressor. They are widely used for oil and grease sealing on motors, materials handling equipment, and many other types of moving machinery. In some applications they require no attention whatever for the life of the machinery to which they are attached.

In the present article, however, we are concerned only with their use on process pumps, mainly centrifugal, which have rotating shafts and which must combat abrasives carried by the liquid. For such use they have a number of advantages that are relatively well accepted. For example:

 They offer a great saving in both materials and labor for repacking and adjustment of the packing.

 They greatly reduce wear on the shaft or shaft sleeve, such as occurs in the stuffing box of a conventional packed pump, thus avoiding need for frequent replacement.

 They virtually eliminate leakage and in time can save considerable money by preventing loss of expensive products.

• For the same reason they enhance safety in the handling of toxic or flammable materials.

When abrasives are present in process pumps the packing gland problem becomes much more severe. Because it can largely eliminate the problem, the mechanical seal for abrasive applications can lead to maintenance and other savings which far surpass the already recognized advantages of such seals in the non-abrasive field.

The Seal Principle

Before we get into the ways of using mechanical seals on abrasive applications, it will be well to review briefly how they work and what their major variations are.

Although there are a great many design variations in seals, all operate in substantially the same way so far as the actual sealing surfaces is concerned. Two highly finished flat surfaces in rubbing contact with each other separate the region of pump stuffing box pressure and the outside, or atmospheric-pressure, region. One surface is attached in a leakproof manner to the shaft, and rotates with it. The other is attached leaklessly to the pump casing or some part of the stuffing box, and hence is stationary.

Generally it is secured by a gland held by four bolts to prevent warping of the seal faces.

The simplest possible arrangement would be to machine a shoulder on the shaft which would bear against a smooth surface on the casing, as in Fig. 1a. Thus the seal is seen to be a flat and highly finished form of thrust bearing. Ordinarily such a seal relies on a small amount of leakage for lubrication. Also, as in any bearing, the materials of which the mating surfaces are made must be suitable for the service, that is, they must not gall or seize. They will ordinarily be different materials. Among the many materials used for the mating faces are metals and alloys such as cast iron, bronze, stainless steel and other nickel alloys, the Hastelloys and Stellite. Among the non-metallics are carbon-graphite, various ceramics, various carbides, and Teflon, both carbon and glass filled. One of the surfaces is generally of carbongraphite. Ceramics and ceramiccoated metals are coming into increasing use. Sometimes hardsurfaced metals are used.

Even with properly matched materials for the mating surfaces, the seal of Fig. 1a would not be satisfactory for several reasons. First and foremost, it would be impossible to attain and then maintain the proper contact pressure between the surfaces. In addition, it would be difficult if not impossible to secure exact parallelism. Furthermore, this arrangement would not take care of end-play or run-out of the shaft, which are unavoidable to at least a small extent. All actual seals therefore incorporate variations into this basic design which overcome the difficulties mentioned and also provide for initial installation, adjustment, repair and replacement.

Actual Seals

All seals retain the principle of the two mating surfaces at right angles to the shaft (Fig. 1b, c) one driven with the shaft and called the sealing ring, the other attached to some part of the casing and called the mating or gland ring. Usually the mating ring is secured with relatively little flexibility to the casing, while the sealing ring is mounted flexibly so that it can move endwise under spring pressure to maintain constant contact pressure against the mating ring. In the event of a small amount of shaft whip or run-out, the sealing surfaces remain in contact and perpendicular to the shaft at each point of shaft rotation.

Two principal methods are used to keep the mating surfaces in contact. The more common (Fig. 1b) is to have one or more springs bear on the movable sealing ring. Less commonly, a flexible bellows or diaphragm (Fig. 1c) provides at

least part of the desired spring action.

Sealing of the movable sealing ring to the shaft may be accomplished in the same way, that is, by use of a diaphragm or bellows. Generally the bellows (Fig. 1c) serves mainly as a seal, its spring action being supplemented by a spring. More commonly, the sealing ring is packed to the shaft by some form of flexible non-metallic packing (Fig. 1b) such as an O-ring or chevron ring; or for high temperatures, flexible metallic chevron rings may be used. The stationary or mating ring is ordinarily mounted in the outer end of the packing box and sealed by means of a more or less flexible gasket or an O-ring.

Although the success of a mechanical seal depends on many factors, including proper choice of materials and adequate sealing methods, no seal can be successful unless the mating surfaces are extremely flat and smooth. Faces are customarily finished by lapping to a flatness within two or three light bands (0.000025-0.000035 in.), as determined with an optical flat used under monochromatic sodium light. (For a good brief description of this method of determining flatness, see Elonka, Power, Mechanical Seals Manual, Mar. 1956, p. 116.)

Design Variations

The designs of mechanical seals are numerous, but most of them can

be grouped under a few broad types:

Packing-sealed or bellows-sealed Stationary or rotating Inside or outside

Unbalanced or balanced Single or double

A few words of explanation will make these various characteristics clear. The first, relating to the method of sealing, has already been discussed.

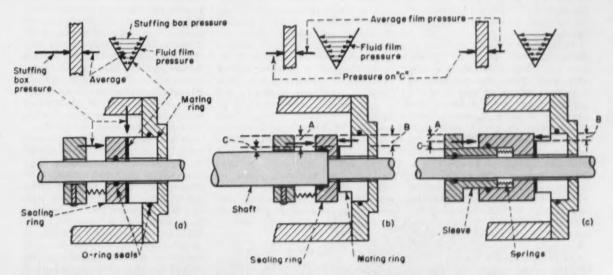
Stationary or Rotating-In all mechanical seals one ring rotates with the shaft, while the other is stationary. When these terms are applied to the entire mechanism, they refer to whether the preponderance of the parts are stationary or rotating. Most pump seals are of the rotating type in that the flexibly mounted ring and its associated mechanism (springs, collars, driving means and packing) all rotate with the shaft. In a socalled stationary seal, the flexible ring and its associated mechanism do not rotate, but only the mating ring which is attached to the shaft.

Inside or Outside—The inside seal, which is the more common type, has the flexibly mounted ring and its associated mechanism all inside the pump (usually inside the stuffing box), and completely submerged in the liquid. An outside seal has the flexibly mounted ring and its associated mechanism outside the pump where it is readily reached for adjustment. Outside seals, despite their convenience, are

less used than the inside type since they are suitable only for low pres-

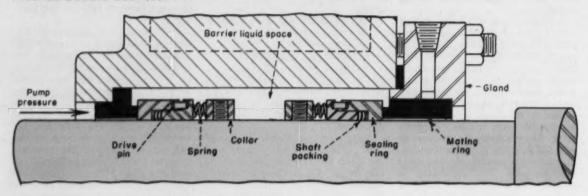
Unbalanced or Balanced-The flexible sealing ring of a mechanical seal (Fig. 2a) is subjected to the hydrostatic pressure of the liquid in the pump stuffing box, which forces the ring against the stationary mating ring. However, there is also an opposed variable pressure within the fluid film between the mating surfaces of the two rings, (shown in the pressure diagram) which tends to force these surfaces apart. The pressure here varies between stuffing box pressure on the inside, and atmospheric pressure on the outside. Since the pressure variation is substantially linear from inside to outside, the average film pressure between the mating faces is about half the stuffing box pressure. The net pressure acting on the sealing ring is therefore the difference between the stuffing box pressure acting toward the right, and the average film pressure acting toward the left. As shown in Fig. 2a this about half the stuffing box pressure. This resultant pressure, times the seal face area, is the force pushing the faces together in an unbalanced seal.

For lower pressure operation this amount of force causes no trouble. However, for pressures generally above about 100-125 psi. the usual practice is to employ a partially balanced seal. Here the amount of

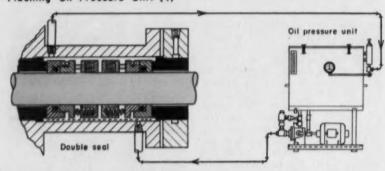


Arrangement in (a) results in unbalanced pressure on seal ring; modification as in (b) or (c) permits balancing. (Fig. 2)

Flushed Double Seal (3)



Flushing Oil Pressure Unit (4)



area of the flexible sealing ring subjected to unbalanced forces is reduced in one of several ways. The effect is to reduce the net pressure forcing the sealing faces together so that the total closing pressure (including the spring pressure) is only enough to maintain seal face contact.

There are two main methods of doing this. One, shown in Fig. 2b, is to cut a step in the shaft on the side away from the pressure so that the pressure on area B of the sealing ring counterbalances the pressure on area A, leaving only the pressure on area C to be partially balanced by the film pressure between the sealing faces. Obviously, as this sketch shows, the relation between the outside diameters of the sealing and mating rings controls how much pressure differential is thus balanced out. The second method, Fig. 2c, is the same in principle as the first, although it differs in appearance. Here the sealing ring is step-cut on the inside and sealed to a collar on the shaft. The pressure on area A

is thus reduced by the counter pressure on area B, leaving only the pressure on area C to oppose the film pressure existing between the seal faces.

Single or Double - Ordinarily only a single mechanical seal is necessary. However, for a number of special applications, two seals can be used back to back, with a liquid supplied to the space between them at a pressure higher than that of the stuffing box. This liquid is usually a lubricant, but it may be a process material or water in some cases. With a double seal none of the pumped liquid can escape to the atmosphere-unless it is also used as the seal liquid. Hence, double seals may be used for handling extremely toxic or hazardous materials. The method also facilitates seal cooling, and guards against the possibility of sudden failure of the inner seal.

Seals for Abrasives

There are two principle ways of getting at the seal problem when

the pumped liquid carries abrasives:

• Keep the solid particles flushed away from the seal parts.

• Use extremely abrasion resistant seal faces.

Thus far, for handling abrasive liquids, there has been only limited success with the second method in which abrasion resistant seal faces are used. Where it has been properly applied, the first method—flushing the solid particles away from the seal faces—has been quite successful. Most failures where this method has been adopted have been due to inadequate measures taken to insure a flow of clean liquid across the seal faces and parts.

Keeping Solids Away

Several different means are used to keep the seal parts free of solids. Those that will be discussed include (1) use of double seals with flushing liquid between them; (2) use of single outside seals with a flushing gland; (3) use of single inside seals with a flushing gland; (4) use of single outside or inside seals with a flow-control bushing or lip seal; and (5) use of seals with face lubrication.

Double Seals—Although double seals are less common than single in non-abrasive application, their use is the commonest method of conquering difficult abrasive problems. Fig. 3 illustrates this type of seal. Between the two back-to-back single seals a barrier liquid is maintained, generally a light oil at 25 to 50 psi. higher pressure than that existing on the impeller side of the seal. The barrier liquid insures a clean oil film between

the seal faces, thereby preventing entrance of abrasive particles between the faces. Usually a regular barrier liquid system, complete with with an individual pump, pressure tank, gages and other parts, is installed with a double seal job. Fig. 4 shows a satisfactory system for low pressures. However, where there are exacting pressure requirements, a more expensive pressure control unit which maintains a fixed differential pressure above the stuffing box pressure may be needed.

Contamination of the product by the barrier liquid is so slight with systems of this type as to be rarely objectionable. Sometimes even this small contamination can be avoided by using a clear stream of the product liquor as the barrier liquid. In other cases the barrier liquid may have properties of some special value. For example, alcohol—a solvent for phenolic resins—has been used as the barrier liquid on a phenolic varnish pump to prevent solids build-up on the mating faces.

Advantages and Disadvantages-The double seal has an important advantage in some cases in that the outer seal will hold the liquid until the pump can be taken off the line if the inner seal should fail. A single seal will suddenly fail only on rare occasions, but it does offer this possibility. In contrast, an ordinary packed stuffing box will always give warning and will never fail suddenly. The double seal also is suited for very high pressures. It can be used for somewhat higher temperatures than single seals since the barrier liquid can be used not only to balance out the high stuffing box pressure, but also to keep the mechanical parts of the seal at a sufficiently low temperature.

Against these advantages must be weighed the disadvantages of the double seal. It is relatively expensive and therefore should not be considered if a single seal will do the job. It is generally the most complex seal for the plant mechanic to install. It requires a greater length of stuffing box than any other type. Probably its weakest point is the shaft packing for the inner seal. It is common to overlook the fact that there is direct contact of the inner seal packing with the liquid being pumped when double seals are being used.

Flushed Outside Seal-A typical outside seal equipped for flushing is shown in Fig. 5. It is apparent that the seal springs and means of seal adjustment are all completely outside the pump where they can easily be inspected by the pump mechanic. A clear flushing liquid is introduced into the stuffing box, preventing abrasive material from reaching the faces. In this particular seal the carbon rotating ring runs against a stationary Stellited seat. Leakage along the shaft itself is prevented by a wedge-shaped Teflon ring. If a clean flushing liquid is provided continuously, a seal of this type should function very efficiently.

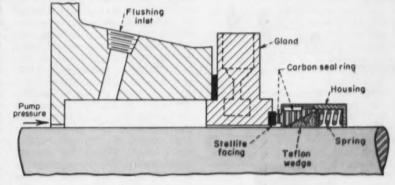
In seals which rely on flushing to keep solids away, the leakage clearance must be small enough to maintain a high velocity in the clearance, so as to jet solid particles away. A velocity of about 10-15 fps. is generally desired at this point. To reduce clearance this system uses a flushing or restric-

tion bushing which has some weaknesses, but is vastly superior to many installations where flushing is attempted without any restricted clearance between the mechanical seal and the pump impeller. In such case the flushing liquid velocity is too low to be effective in preventing solids entrance into the stuffing box.

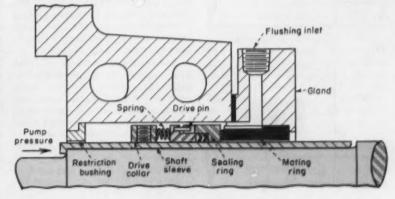
Flushed Inside Seal—Fig. 6 shows a typical inside seal with a flushing gland. It uses the same principles in applying a clear flushing liquid as in the case of a flushed outside seal. It is desirable that the clear flushing stream be directed across the sealing faces. Use of a restriction bushing reduces the flow of flushing liquid and hence its cooling effect. In some circumstances this may allow overheating unless jacket cooling is used.

The inside seal is more readily balanced and therefore can carry higher stuffing box pressures than an outside seal. For example, inside seals are commonly made for

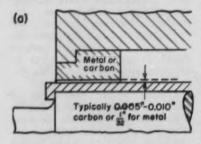
Flushed Outside Seal (5)

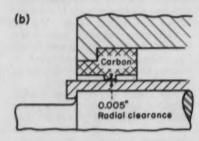


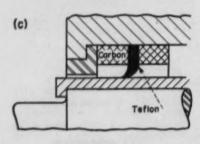
Flushed Inside Seal (6)

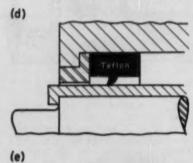


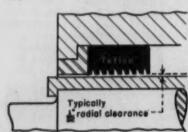
Restriction Devices (7)











stuffing box pressures as high as 600 psi., whereas outside seals, even when balanced, are limited by some manufacturers to 150 psi., and by others to 50 psi., service pressure. However, the outside seal is more readily adjusted as we have already noted. Furthermore, if the flushing liquid supply should fail, the rotating elements of an inside seal might be damaged, but in an outside seal they would not be touched by the contaminated liquid.

Comparing the two types point for point, I believe that the outside seal is superior to the inside type for abrasive applications, except where the stuffing box pressure is too high.

Flushing Flow Control-In discussing the flushed outside seal we have already taken note of the use of a flushing bushing to keep down the necessary quantity of flushing liquid, and still give a high flushing liquid velocity which will prevent the entrance of solids into the stuffing box. The ordinary flushing bushing (Fig. 7a) has a few design limitations. Other devices, to be described (Fig. 7b-e), have been introduced to overcome them. For example, its close clearance requirement can be met satisfactorily with the better designed shafts, but may cause trouble with some pumps. Where shaft diameters are too small, the bushing may be damaged by either shaft deflection or whip. Then clearances will soon be worn so large that the mechanical seal will no longer have the protection of proper clear liquid flushing. The running clearance should be designed to give 10-15 fps. velocity of the flushing liquid across the clearance, so as to jet ahead of it any solids trying to enter the stuffing box cavity. When the pump is shut down, small abrasive particles may wedge between the bushing and the shaft. This may lock the bushing, or grind it severely the next time the pump starts. Hence, flow should be maintained during pump shut-down.

Another disadvantage of the flushing bushing is that solids may penetrate behind it and settle around the seal parts when the pump is down for a number of hours. However, the troubles noted during pump shut-down cannot occur if the flow of flushing liquid is maintained while the pump is off the line.

Several methods to overcome the

disadvantages of the ordinary flushing bushing are indicated in Fig. 7. At b is a bushing with a a single close-clearance projection cut on its inner surface. As used in one plant this projection is about in. long and clears the shaft by about 0.005 in. It provides a scouring or self-cleaning action on solids which may collect along the shaft. This same plant has tried internally serrated bushings to reduce the flow coefficient to very low values, but has found that the serrations quickly fill up with scale or other solids which reduce their effective-

The other methods sketched in Fig. 7 show alternates to the close-clearance carbon bushing, all suitable for both inside and outside seals. Sketches c and d have been used experimentally in a few isolated instances and thus far have about 15-20 months of successful operation behind them. The type shown in sketch e is still in the idea stage.

Lip Seals—Sketches c and d show lip seals which are both very effective. Type c has been used in several applications by one large user. It employs a truncated Teflon washer 1/32 in. thick, held between stationary carbon bushings in the packing box. These parts are carefully assembled so that the Teflon ring rubs the shaft with an interference fit and is flexed in the proper direction during installation. This causes the lip to act as a check valve against back-flow into the mechanical seal when the pump shuts down. In one application using a 11 in. diameter shaft sleeve a pressure differential of 30 psi. is required to produce flow under the lip toward the pump. The lip holds a 75 psi. differential without leakage toward the seal when the pump shuts down. Owing to the flow resistance, only very small quantities of flushing liquid,

as little as ½ gph. are required.

A very similar seal, sketch d, is used in another plant where the lip ring and supporting bushing are one piece of solid Teflon. The lip is cut to operate with about 0.002 in interference fit with the shaft. The assembly is pressed into the stuffing box, after which the shaft is pushed in so that the lip lies along the shaft, pointing toward the impeller.

An idea quite similar to sketch b is shown at s. This is a solid Teflon bushing with internal ser-

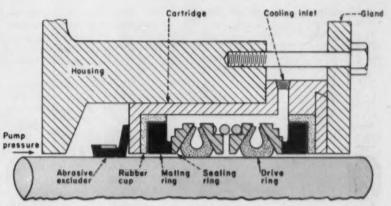
rations, having a typical clearance of in diametral. I do not believe this bushing could be designed for an interference fit since its power absorption would be too great. Like sketch b. the serrations of this bushing would act as throttling devices and should function well with very little flushing liquid flow. Use of Teflon in such a bushing has some advantages over carbon or metal since in operating at close clearance its flexible lips would accommodate a certain amount of shaft deflection or whip without loss of sealing effectiveness. With any serrated bushing, of course, the effectiveness of the serrations will be lost if they should become clogged with solids.

One manufacturer is now prepared to supply this last bushing for trial.

Still another variation of the lipseal idea is available as an integral part of a commercially produced seal. This is a cartridge-type double seal, shown in Fig. 8. At the impeller end of the cartridge is the "abrasive excluder" which is a flexible device attached to the shaft sleeve and running against the end of the cartridge. It is held tight by pump pressure. Clean liquid can be injected into the cartridge at higher than pump pressure to cool the seal. An almost negligible amount of the liquid is then thrown out by the abrasive excluder, keeping its running fit clean.

In addition to its abrasive excluder this seal has some other novel features as Fig. 8 shows. It uses flexible synthetic rubber driving rings which grip the shaft and also act as shaft packing. The design allows for a variety of materials such as carbon, stainless steel or Hastelloy for the sealing rings. The parts made of synthetic rubber, such as the excluder, driving rings and the cup mountings for the sealing rings can be made of Kel-F if necessary for temperature or other reasons. The abrasive excluder feature could be applied to other types of mechanical seals, but this would require a stationary bushing in place of the back surface of the cartridge. The cartridge arrangement is easier and more practical to install.

Practice in regard to lip seals and restriction bushings has not yet had time to crystallize. Some seal makers feel that these devices



Variation of lip-seal is the abrasive excluder in this commercial seal. (Fig. 8)

should be provided by the pump manufacturer or by the user. Others think the seal manufacturer should provide them. This question of supply will doubtless be settled as these devices come into more regular usage.

Excluders, lip seals and restriction bushings are evidently a valuable adjunct to seals in abrasive applications. One specific performance record is worth mentioning. As of June 1 this year, a lip seal of the type in Fig. 7d had been operating continuously for 16 months. At the end of the first 8 months the pump was disassembled due to a ball bearing failure. At that time the Teflon lip had been roughened very slightly, as well as the sleeve area it contacted. However, these surfaces were not damaged enough to require change. The seal was replaced intact and has been operating ever since. The pump is handling a liquid which is basically clear, but gradually accumulates a small amount of very abrasive coke dust. Before the auxiliary lip seal was added, this dust rapidly wore out the seal faces. The user is planning another lip seal installation owing to the success of the first.

Face Lubrication—An inside single-spring seal designed for lubrication of the seal faces to prevent entrance of abrasive particles is shown in Fig. 9. This particular application is used on cocoa paste at 250 rpm. and 150 psi. Face lubrication is introduced through the gland insert. Usually a narrow circular channel is cut in the middle of the insert face so that the lubricant keeps the channel full. A mechanical lubricator or

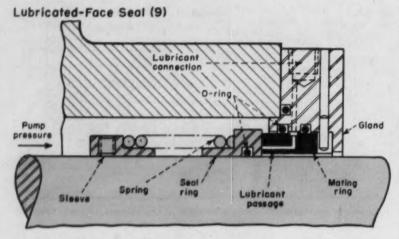
a gravity tank is generally used to feed the lubricant. A danger with this system is that a sudden pressure surge from the lubricant line might blow the faces apart and cause heavy leakage.

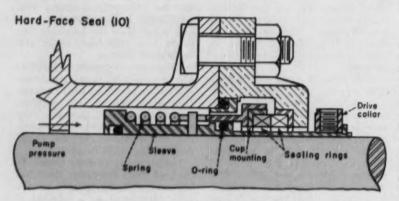
Whether a face-lubricated seal will be successful in any particular application cannot be predicted, unfortunately, but can only be determined by trial. However, the method is an excellent one for keeping contamination of the liquid down to negligible proportions.

Un-flushed Hard-Face Seals—To the best of my knowledge there has been no uniform success so far with hard faces as a solution of the mechanical seal problem. Even if the hard faces last a reasonable time, there is always the possibility that the shaft packing or the springs may fail as a result of filling up with solids. I do not believe that hard faces can yet beat the seal problem, but some of the facts regarding their present limited success should be considered.

Fig. 10 shows one seal design using extremely hard face materials. This cartridge type seal with a single spring and O-ring shaft packing is secured to the shaft by an external drive collar. In it the abrasive liquid recirculates through the gland across the faces and back into the pump. No attempt is made to clean up the circulating liquid, but the liquid must circulate steadily throughout the seal so as not to allow solids to settle and fill up the box.

In seals of this type tungsten carbide materials such as Carboloy can be operated against each other at reasonably high speeds and pres-





sures for long periods of time without galling. Sometimes the more expensive boron carbide is substituted as the seal ring material. Rings of these particular alloys have to be mounted in resilient cups. If the mounting cups are of rubber, this limits their chemical resistance and prevents use of a cup temperature higher than 250 F. Also it is sometimes hard to hold down the temperature at the sealing faces since there is more friction between faces of this type than with the standard material combinations such as carbon and metal.

In one case a seal of this type is operated on Bordeaux Mixture for periods of 3-6 months without servicing. At the end of this time the impeller volute has to be replaced anyway, so the seal faces are replaced during this general overhaul.

Quite possibly more could be done with chrominum carbides. These hard materials average a hardness of 74 Rockwell C, which is quite satisfactory. They can take an optically flat finish, have a low coefficient of friction, and possess a good degree of resistance to most corrosive liquids. They are chromium-carbon compounds sintered with nickel. Their corrosion resistance is generally equal or superior to that of the 18-8 stainless steels.

Providing For Axial Movement—In many semi-open slurry pumps the impeller can be adjusted to make up for a reasonable amount of lost clearance due to wear. In most cases the readjustment of the shaft position does not change the seal adjustment critically, although this may not be true in large pumps. Fig. 11 shows a design which provides for easy seal adjustment to compensate for adjusting the shaft for wear.

This particular seal is an outside type, used on a coal washer pump with a 3½ in. shaft. About 1½ gpm. of clear water fed into the long carbon insert is used to lubricate the mating surfaces and keep solids flushed away. When the pump is shut down, the flushing flow is maintained, but cut to about 1 gpm., flow being controlled with a rotameter. When shaft repositioning is required due to wear, the rotating collar is repositioned by loosening the clamping cap screw and sliding the collar along the shaft to a new location where the gap between the collar and the seal ring is 1 in. (as specified by the manufacturer). Thus the adjustment advantage of the outside seal, coupled with a simple clamp-type collar, makes for easy maintenance in an application where frequent shaft repositioning is expected.

Shaft Packing For Seals

It is not generally recognized how often trouble with mechanical seals comes from failure of the shaft packing, rather than the sealing surfaces. The principal types of shaft packing (Fig. 13) include the O-ring, Quad ring, wedge ring, chevron ring and square ring. Ordinarily these are of non-metals although the chevron type is also supplied in metal for higher temperatures.

In abrasive applications, the worst effect of the solids on the shaft packing is their tendency to freeze or lock the packing to the shaft. When that occurs the springs can no longer apply pressure to keep the mating surfaces in contact.

Therefore, it is desirable to keep the solids away from the shaft packing if possible. With single seals, both inside and outside, the shaft packing can be protected by proper flushing. In a double seal the shaft packing of the inner seal contacts the liquid being pumped in spite of the use of a barrier liquid at proper pressure. With face lubrication and no flushing the same problem exists.

One way to get away from the shaft packing problem is to eliminate the packing by use of a bellows seal as in Fig. 12. In this design a Teflon bellows is locked to the shaft, holding the rotating seal ring so that it can move axially. This device is claimed to remove the possibility of shaft packing failure, but it can be used only on outside seals (in this particular design) and so is limited to relatively low pressure. Use of the bellows also eliminates the possibility of local

corrosion which sometimes occurs between packing and shaft sleeve.

With packed shafts there is a possibility of either local corrosion or erosion where the packing slides on the shaft or shaft sleeve. This can be counteracted by a local coating of hard, corrosion-resistant material.

Such coatings include ceramics, chromium, and hard alloys such as Colmonoy and Stoodite. Chromium is a poor choice on many types of corrosion since the coating is porous and allows corrosion to take place between the coating and the parent metal, with subsequent peeling of the chrome. Ceramic coatings have been very successful, having a hardness of 9 on Moh's scale.

Either the user or the pump manufacturer can send the sleeve to the seal manufacturer who will undercut it and apply either ceramic or hard metal to the area which will run against the seal packing. A typical charge for ceramic coating is about \$30 for a 2-in. diameter sleeve.

O-Rings—The advantages of the O-ring are well known. One disadvantage is its tendency to roll or twist on sliding movement. When made from the usual rubber and rubber-like materials it is limited to relatively low temperatures, while it may swell or deteriorate in many organic chemicals.

Quad Ring—The Quad ring, b in Fig. 13, is a newer type for which the applications on mechanical seals are now growing. It does not tend to roll or twist on assembly as do O-rings. Its break-away pressure is less than that of the O-ring, meaning greater freedom of movement between the parts it is used to seal. With rapid variation in stuffing box pressure this low break-away pressure makes the Quad ring less likely to leak than an O-ring.

Wedge Ring—Sketch c in Fig. 13 shows a wedge ring. In Fig. 5 a wedge ring is used as the shaft seal, bearing against the wedge surface of the sealing ring. Compression of the wedge against the seal ring forces the wedge packing against the shaft to seal off potential leakage. This is in contrast to the Quad and chevron rings, where liquid pressure spreads the ring to press it against the shaft. The wedge ring exposes more surface to the shaft and less to the stuffing box pressure than the Quad or chevron rings. This characteristic is a good

one for holding pressure, but it is poorer from the standpoint of possible freezing to the shaft due to solids build-up or deterioriation from high temperature or corrosion.

The question of the best type of shaft packing is by no means settled and there is no agreement among seal manufacturers. Both chevron and wedge have had years of successful application, but the Quad ring is a newcomer.

Chevron Ring-For many years the chevron ring, sketch d, has been used successfully in packing against both rotary and sliding motion. If the liquid pumped permits the use of rubber or a rubber-like material, O-rings can be used. But if such materials cannot be used, then a U or V shaped chevron in such a material as Teflon may be the answer. The close contact needed for sealing is obtained by spreading the U or V by means of the seal compression ring. Or, alternatively, the chevron can be reversed so as to be spread and forced against the shaft by the fluid pressure. Compression ring pressure is limited to relatively low values by practical considerations of spring design in mechanical seals. For this reason the chevron must be reversed and spread by fluid pressure in seals for higher pressures. For temperatures still higher than those suitable for Teflon chevrons, the ring may be made of metal. Metal rings are recommended on abrasive handling pumps only when temperature is the limiting factor.

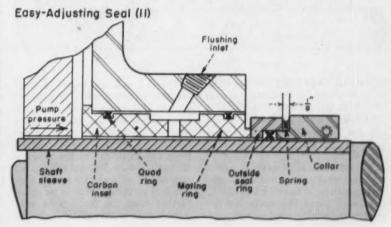
Where a non-metallic material would probably seal a small nick in a shaft sleeve, a metal ring would not do so but would provide a path for leakage. For this reason its use requires a very high degree of shaft finish. The metal U-chevron is new and there is still too little experience with it to warrant more comment at present.

Interchangeability

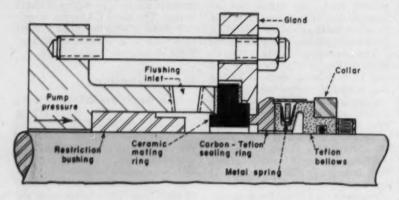
Many people are still hesitant to try mechanical seals. So, in trying a seal the user may want to be able to convert back to a packed stuffing box if unforeseen complications should develop. Furthermore, it may be necessary to go back to packing of the stuffing box if a seal should break down when adequate replacement parts are not on hand. Designers have been keeping the interchangeability problem more in mind on new pumps. For example, Fig. 14 shows a feature of the new Dean Bros. GS pump in which the standard stuffing box pump gland is recessed on its back face. By simply reversing the gland in the field it can be used either to provide compression on standard gland packing, or to secure a mechanical seal in place. No modifications are needed for either method of sealing. If a new pump equipped initially with a seal should fail, then standard packing can be substituted for it immediately.

With such an arrangement, of course, an extended run with conventional packing may roughen the shaft sleeve to the extent that a new sleeve will be needed when converting back to a mechanical seal.

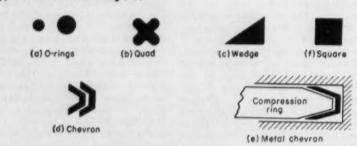
A similar idea, could, of course, be applied to a variety of the pumps in medium pressure service. Users would do well to check the possi-



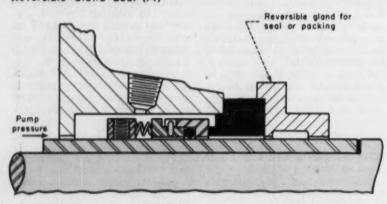
Tefion-Bellows Seal (12)



Typical Shaft Packing (13)



Reversible-Gland Seal (14)



bility with their pump vendors so as to be prepared for emergency operation with the stuffing box should a seal fail at a critical time.

How Much Flushing Liquid?

As yet there is no general agreement on what constitutes an acceptable quantity of flushing liquid. In one large plant the operating department usually allows \(\frac{1}{2} \) gph., but

considers 5 gph. excessive. A compromise is often made at about 2 gph. in applying a lip seal flush. In many processes—for example fatty acid work—a clear liquid product suitable for flushing can be obtained from the finish end of the process. In such a case the quantity used may not be critical. Or it may happen that an inhibitor is to be added farther down the line. With only minor piping changes it may be

possible to introduce the inhibitor through the pump stuffing box and provide flushing for the mechanical seal at the same time. Thus close cooperation between the operating personnel and the project engineers will often uncover a source of clear flushing liquid which will not be harmful to the process, and will also establish a flow rate that can be tolerated.

Quite likely future seal designs may permit external adjustment of the restrictive device between the impeller and the seal faces, thus making it possible to adjust the flushing flow rate for best results. This could by externally adjusting the inside seal of a double seal. However, the few attempts I have seen so far to introduce adjustment at this point have not yet proved practical enough to justify inclusion in this article.

At present, therefore, it is of interest to be able to predetermine the amount of flushing liquid by design of the restriction bushing. I have not been able to correlate the available data to permit computing the velocity and quantity of flow that will take place between the shaft and a close-clearance flushing bushing, but some general comments on this subject may nevertheless be helpful.

Most of the common fluid-friction formulas, such as the well-known Darcy formula, are based on the flow resistance of one pipe fitted into another, and give velocity values higher than those I have seen in the field. Also, the recent ASME paper of Tao and Donovan (ASME Trans., p. 1291-1301, Nov. 1955) shows that lower velocities exist through close-clearance bushings.

These authors deal with flow through fine annular clearances, both eccentric and concentric, with or without relative motion of the boundary surfaces. Fig. 13 of their paper, on which Fig. 15 here is based, enables determination of laminar flow velocity through such clearances when the liquid is water at 68 F. and the clearance is concentric. The chart is based on a friction factor equal to 96/Re, where Re = Reynolds number.

The experiments on which this chart was based (as well as a comparable chart for turbulent flow) dealt with longer axial clearance lengths and higher differential pressures than would be applied in the

usual flushing system, but they still give a good picture of the effect of pressure differential and clearance on velocity. For example, as shown, with a pressure differential of 20 psi. and a sleeve length of 2 in., the axial velocity through a 0.005 in. clearance would be about 12 fps. Should the reader want to see the effect of running deflection of the shaft (eccentricity), he can refer to Fig. 11 in the ASME paper.

Data along this line are also provided by Stepanoff (A. J. Stepanoff, "Centrifugal and Axial Thrust Pumps," John Wiley and Sons, Inc., New York) in his discussion of leakage loss across centrifugal pump wearing rings.

Some actual data are available from an installation in one large chemical plant where close-fit bushings of this type are used. The bushing is of hard carbon, machined to fit the stuffing box bore and turned down internally to \(\frac{1}{2} \) in. radial clearance except for a \(\frac{1}{2} \) in. long projection near the center as in Fig. 7b. The projection has a clearance of 0.005 in. In tests on a \(1\frac{1}{2} \) in. shaft rotating at 3,500 rpm., a differential pressure of 15 psi. gave a flow velocity of 7 fps. and a flow quantity of 1.2 gph.

Information is also available on the flushing liquid requirements of the Wedge-Lock outside seal made by Chemical & Power Products, Inc. In this seal a tapered bushing, generally of Teflon, is pushed to the bottom of the stuffing box during installation to support the stationary carbon mating ring and seal it to the stuffing box. This bushing generally clears the shaft by 0.005 in, and so can serve as a closeclearance flushing bushing. In one application handling a diatomaceous earth slurry the flushing liquid is clear water and the measured flow through the bushing clearance is 2-3 gal. per 24-hr. day. In another application handling a slurry suspended in acetone, clean acetone from a gravity tank above the pump flushes and lubricates the in, seal. Here the measured flow through the bushing is only 1-11 gal. per 24-hr. day. These applica-tions show that flushing inflow to the pump can be held down to very low quantities in practice.

How About Seal Cooling?

When handling abrasives the principal effect of the flush liquid

is to exclude solids. However, the secondary effect of cooling the seal may be important and can be beneficial to seal life, even at low pumping temperatures.

Cooling has several advantages. It prevents excessive temperature of the seal faces and keeps the pumped liquid from vaporizing around the seal. When handling flammable liquids it reduces possible hazard. It reduces any tendency for deleterious effects such as distortion on parts of the seal. And it slows down any tendency toward corrosion of the seal by the material handled.

Cooling can be accomplished in several ways. Usually water is the coolant, and is circulated through confined passages in the glands, inserts or bushings. The liquid may be circulated through a shroud or cowl type gland extending partially over the seal ring of an outside seal. The stuffing box may be jacketed and the coolant circulated through the jacket. Or it may, as noted, be circulated between the two seals of a double seal. Sometimes, instead

of using water as the coolant, some of the pumped liquid may be bypassed through the stuffing box or gland.

In a number of special cases the coolant may be a lubricant, clean process liquid from farther along in the process, or some process additive that can be properly added at this point.

Ambient Effects

In addition to temperature and pressure, certain conditions of the operation are worth noting for their effect on seal performance. For example, a liquid of high surface tension (the ability of a free liquid surface to resist a tensile stress) permits maintaining a wider gap between the seal faces. Liquid viscosity affects the flow across the seal faces just as it would across an orifice, high viscosity reducing the seal-face leakage.

In the case of non-flushed seals, size of suspended particles has an important effect. Particles smaller than 200 mesh are likely to be

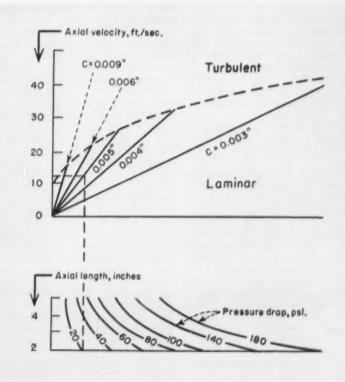
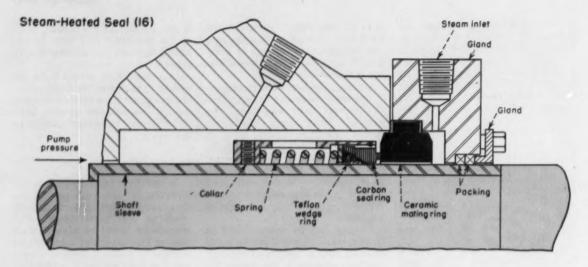


Chart after Tao and Donovan shows flow velocity through clearances. (Fig. 15)



trapped between the faces, causing grinding action, face separation and severe leakage. Fine particles, e.g., fullers earth, are extremely trouble-some. Many seals which looked promising after tests with sand and water failed quickly on small particles for this reason.

Volatilization (and conversely, freezing) in the seal are other sources of trouble. A low viscosity liquid of high volatility sometimes flashes into vapor at the seal temperature, destroying the thin film between the faces. This difficulty can be cured by using cooling, or lower operating temperatures. It may also be cured by lubricating the faces with lower flash-point material, substituting face materials of lower coefficient of friction, or modifying the pump liquid end to produce a lower stuffing box pressure.

If freezing, instead, is the problem—as it may be for example in a molten sulfur pump—heating of the gland and stationary face is called for, as in Fig. 16. Here 150 psi. steam is circulated through the gland to keep face temperatures high enough to prevent solidification of the molten material. An auxiliary packed stuffing box is provided to prevent steam leakage.

An auxiliary packing similar to the one used here to hold steam pressure is sometimes used in applications which are not steam heated to act as a second line of defense in the event of a sudden failure of the mechanical seal.

Pressure-Speed Effects

Apart from other service conditions, the relation of face pressure to the rubbing velocity of the seal faces plays a major influence in the life of a seal, as in other kinds of bearings. In the past there have been arbitrary limits set for unbalanced seals regardless of size, speed, mating face materials, or liquid being handled. Various makers have set the limit at 100, 150 or 200 psi. Certain refineries have even gone so far as to standardize on balanced seals whenever stuffing box pressures exceed 50 psi.

Such pressure limitations have been established largely from field Recently, however, experience. Durametallic Corp. has completed an extensive laboratory and field testing program which permits face life prediction in terms of peripheral speed and pressure for various combinations of face materials and various types of liquid pumped. When these results are made available I believe they will permit choice to be made between balanced and unbalanced seals on pressurevelocity considerations. Also they may contribute materially to the user's ability to shift materials or change his seal or stuffing box designs and thus secure a longer seal

A few words of warning are appropriate before closing this article. Many of the ideas described have had very limited field testing. A few have never been used. Mechanical seal application on abrasive liquids calls for careful planning and diligent maintenance. However, bearing these facts in mind, much is to be gained through use of seals, with far greater advantage than came from the shift to seals in non-abrasive applications.

An important factor in the success of abrasive seal applications is for the supplier to have competent service readily available.

The author wishes to acknowledge his indebtedness to a large number of pump users with whom he has discussed various of the solutions mentioned in this article. He has drawn freely from material provided by seal manufacturers, including Chemical & Power Products, Inc., Crane Packing Co., Durametallic Corp., Garlock Packing Co., Peerless Pump Div., Sealol Corp. and the Syntron Co. Finally, he wishes to mention particularly the helpful comments and suggestions provided by S. M. Elonka of Power Magazine and Irving Taylor of the Lummus Co., as well as several pump users of experimental applications who preferred not to be identified.

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Chemical Engineering Fundamentals

Catalytic Reactor Design Problems—III

How do we size a reactor for nonisothermal, nonadiabatic operation? Here's how to approach this most important case.

T. E. Corrigan and W. C. Mills, Olin Mathieson Chemical Corp., Brandenburg, Ky.

SIZING a reactor for nonisothermal, nonadiabatic operation is more difficult than for either the isothermal or adiabatic cases that we have already worked out (Chem. Eng., July 1956, p. 201 and Aug. 1956, p. 221). In an isothermal reactor, the temperature remains constant throughout the reaction. This means that all of the constants in the rate equation remain constant and we can calculate the value of reaction rate, r, for any given value of conversion, x.

In an adiabatic reactor, the temperature changes continually as the reaction takes place. Therefore, the constants in the rate equation change continually as the reaction progresses. Thus, there can be no direct relation between τ and x.

To size the reactor for adiabatic operation we must know the values of the constants as functions of temperature. Usually, $\ln k = \lceil a(1/T) + b \rceil$. If both the heat of reaction and heat capacity of the reaction mass are known as a function of temperature, we can use an enthalpy balance to give us an equation that relates temperature to conversion. Then for any desired conversion, the temperature can be calculated. Once we know the temperature, we can determine the rate equation constants and then the value of r. In this way we can obtain a relationship between rate and conversion,

The important thing is that this relationship can be established without knowing anything about the holding time or the reactor size.

For the case of nonisothermal, nonadiabatic operation, there is no direct relation between conversion and rate. As the reaction proceeds the temperature changes. This temperature change is caused by two

factors: the heat of reaction and heat transfer through the reactor walls. These two factors are not related to each other and the second one is not related to conversion. Heat transfer through the reactor wall is directly related to reactor length.

Since the relation between reactor length and conversion is the answer we are seeking, it is not available until we have sized the reactor. Therefore, no direct solution is possible. The problem must be solved by successive approximations.

Sizing by Increments

In this method a numerical calculation is made at small increments along the length of the reactor. For each increment of reactor length, we assume an average temperature. We use this temperature as a first approximation and calculate a reaction rate. With this we estimate the degree of conversion in the first increment. Using this estimated conversion and the length of the reactor increment, we make an energy balance to determine the temperature of the increment.

This temperature is used for the second approximation and we repeat the calculation. When the calculated temperature equals the assumed temperature, the first increment is completed. We repeat the calculation throughout the length of the reactor and plot conversion and temperature against length. These plots are made as the calculations progress and help in choosing a reasonably close average temperature for the next increment.

An alternate method is to choose increments of conversion and assume a reactor length for the

Here's Your Guide to the Series on Catalytic Reactor Design Problems

in July

isothermal reactor. Heat transfer at reactor holds the temperature constant. Last Month

Adiabatic reactor. There is no heat transfer into or out of the reactor.

In This Issue

Nonisothermal, nonadiabatic reactor. By far the most important industrial case.

increment. Using the chosen increment of x and the assumed increment of l, calculate the temperature of the increment. Use this temperature to determine the rate constants and then calculate the average rate for the increment, using average partial pressures. Use the average rate to calculate the length of the reactor increment. If the calculated length does not match the assumed length, try again.

This calculation is then repeated for each increment. Length and temperature are plotted against conversion as the calculation proceeds. It is necessary to take small increments because both average temperatures and average rates are used for each increment.

Procedure for Incremental Calculation

Let's select a simplified case that illustrates the procedure to be used in the incremental calculation. Consider the hypothetical reaction

$$A + B \longrightarrow R + S$$

How many and what length catalyst tubes would be needed to convert 1,000 lb. of A per hr. to 95% conversion, using a 20-ft./sec. gas velocity in 4-in. I. D. tubes?

Here's the step-by-step procedure for solving this kind of problem:

- Collect the necessary data and equations.
 Make preliminary calculations to define the
- Make preliminary calculations to define the limits of the problem.
 - Prepare working curves.
- Set up basic equations.
 Try alternate conditions, if necessary, and plot data.

Compile Data and Equations

We will need rate data, thermal data and physical properties. Included in our rate data should be a reliable rate equation and equations or plots of reaction rate constants vs. temperature. For thermal data we will want information about heat of reaction and heat capacities of each component.

The physical properties that must be known include: molecular weights of gases; bulk density of the catalyst; and the density of the individual catalyst pellets.

Make Preliminary Calculations

There are certain preliminary calculations that should be made before we actually begin to work on the problem. They are:

- Calculate rate constants at various temperatures.
- Calculate the heat of reaction as a function of temperature. Calculate the average heat capacity of the reacting mass as a function of temperature and conversion.
- Calculate preliminary heat transfer coefficients for reacting mass to inner tube wall; and for outer tube wall to surroundings. Determine, q_i , the heat transfer per unit length of catalyst tube.

From these preliminary calculations, we can prepare some working curves of: logarithms of the reaction rate constants plotted against reciprocal absolute temperature; mean specific heat vs. temperature; heat of reaction vs. temperature; and of rate of heat transfer per unit length of tube vs. temperature.

Here Are the Basic Equations

We will be using some basic equations for reaction rate, heat transfer and energy balances. They are listed below:

Rate Equations

$$r = k_1 p_A p_B / (1 + k_1 p_A + k_3 p_B)$$
 (1)

$$W/F = \int_{0}^{x} dx/r$$

$$W = \rho \pi D^{2} l/4$$

$$l = \frac{4F}{\rho \pi D^{2}} \int_{0}^{x} \frac{dx}{r}$$

$$\Delta l = 4F \Delta x / \rho \pi D^{2} \tau_{ava}$$
(2)
(3)

Heat Transfer

$$q_l =$$
Btu.-hr./ft. of tube length $q_l = \Delta q / \Delta l$ (4)

Energy Balance Whole Reactor
$$\Delta Hx = MC_{pm} (T - T_o) + q \qquad (5)$$

$$\Delta Hx = MC_{pm} (T - T_o) + q$$
Incremental Energy Balance

$$(\Delta H) (\Delta x) = MC_{pm} (T_2 - T_1) + \Delta q$$

$$\Delta H x_1 = (1 - 0.5x_2) (C_p \Delta T \text{ Reactants}) +$$

$$(x_1 + 0.5x_2) (C_p \Delta T \text{ Products}) + \Delta q \qquad (6)$$

where x_i is the conversion up to the start of the increment; and x_i is the conversion during the increment.

How to Make Incremental Calculation

With these basic equations and preliminary calculations we are ready for a step-by-step procedure that will guide us through the incremental calculations required for the solution of this problem. The procedure is as follows:

- 1. Choose a Δx for the first increment.
- 2. Look up q_1 at average x and the entering temperature indicated by the working curve. (Always use temperature of the previous increment.)
 - 3. Assume a value of Δl .

Constants

a, b

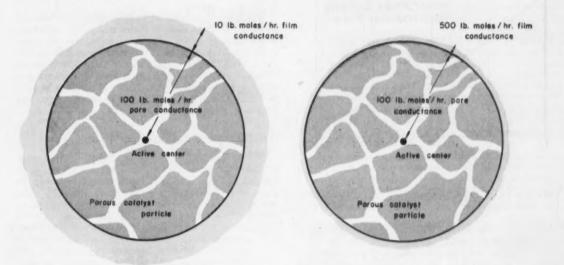
Nomenclature (Consistent Units)

Catalyst density

A, B	Reactants
C	Heat capacity at constant pressure
Cpm	Mean heat capacity at constant pressure
D	Tube diameter
P	Feed rate
Н	Heat of reaction
lp	Mass transfer factor
k, k, etc.	Reaction rate constants
	Tube length
M	Reacting mass
14, etc.	Partial pressure of adsorbent gas
1	Total heat transferred
1:	Heat transfer per ft. of tube length
	Reaction rate
t, S	Products
	Absolute temperature
V	Mass of catalyst
	Degree of conversion
1	Increment of
	3.1416

Diffusion Through Film Controls Reaction Rate

Diffusion Through Catalyst Pores Controls Reaction Rate



- 4. Use the assumed value of Δl to calculate q in Eq. (4).
 - 5. Use Δx and Δl in Eq. (6) to calculate T.
- 6. From calculated T look up corrected k_1 , k_2 and k_3 .
 - 7. Calculate average rate for the increment.
- 8. Using average rate and Δx , calculate Δl by solving Eq. (3).
 - 9. Use this value of Δl to re-evaluate q.
 - 10. Use Eq. (6) to recalculate T.
 - 11. Repeat Step 6.
 - 12. Repeat Step 7.
- 13. Repeat Step 8. If this Δl is close to the assumed value, go on to the next increment of x.
- 14. Keep a working plot of l and T vs. x during the calculation. Extrapolation of these curves during the calculation cuts the trial-and-error to a minimum.

In this type of reactor design problem, the final answer is the length of catalyst tube needed for a desired flow rate and conversion. The tube diameter must be chosen before the kinetic part of the problem is solved. This is in contrast to the isothermal and adiabatic cases with low pressure drop. In those cases W/F is calculated first and tube diameter can be chosen afterward.

Operating With Backmixing

If the reactor to be sized is one in which complete backmixing takes place, the calculation is much less complicated than for longitudinal operation.

Although there is still no direct relation between temperature and conversion, the average values of x and of T are constant throughout the reactor and there are no temperature peaks as might be possible in a longitudinal reactor. Therefore, we can set up equations that relate conversion, length and temperature. We can solve these equations by trial-

and-error without the necessity of numerical incremental calculations.

The simplified equations are:

$$r = k_1 p_A p_B / (1 + k_2 p_A + k_3 p_R)$$

$$W/F = x_f / r_f$$
(7)

$$\Delta H x_1 = (1 - 0.5 x_2) (C_p \Delta t \text{ Reactants}) +$$

$$(0.5 x_1 + x_1) (C_s \Delta t \text{ Products}) + q_A A \qquad (8)$$

where x_i is the final conversion; r_i is the final reaction rate; q_A is the heat transfer per unit area of reactor surface and A is the total reactor surface. The reactor temperature must be such that both Eqs. (7) and (8) are satisfied.

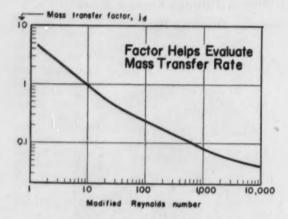
One possible procedure could be:

- · Assume a temperature.
- Calculate or estimate q_4 at this temperature level.
- At the assumed temperature, use Eq. (7) to calculate W/F. When this is done, then calculate the size of the reactor. Next, determine the over-all heat transfer area, A, and determine from this the total heat transfer, q.
- Solve for temperature in Eq. (8). If it is not the assumed temperature, repeat until the correct temperature is found.

What is the Effect of Diffusion?

We presented the examples above on the basis that the partial pressure of each component in the gas stream is the same as that at the surface of the catalyst. This is the case where the resistance to diffusion is not large at the interface. Since there is always some resistance to diffusion, the use of gas stream partial pressure is an approximation. This approximation may be satisfactory for this kind of calculation.

However, there are some cases where the reaction rate on the catalyst surface may be so fast that



diffusion to or from the catalyst surface could be the most important factor setting the over-all rate of reaction.

There are two cases in which diffusion may be the controlling factor (see illustration previous page). In one case there is relatively poor conductance of reactants to the outside surface of the catalyst pellet. This is the case where the catalyst pellets are solid and the reaction takes place only on their outside surfaces or where once the reactants get to pellet, they diffuse readily into the pellet pores.

The second case where diffusion may be a controlling factor is that in which most of the reaction takes place on the internal surfaces of the catalyst, but where the conductance of reactants and products within the catalyst pellet is slower than the rate of reaction on the surface.

When Pore Diffusion Controls

The case where pore diffusion is controlling is common in catalytic reactors and is less difficult to deal with. This is because the relation between diffusion rate and surface reaction for a given catalyst is determined mainly by size, porosity and shape of the catalyst pellets and not by the gas velocity.

Therefore, if the laboratory or pilot-plant reactor used to obtain the original kinetic data contains the same form of catalyst pellets that are used in the commercial reactor, the correction for pore diffusion will be made automatically.

In the case of catalysts where pore diffusion is controlling, laboratory data obtained on a fixed-bed reactor cannot be applied to a fluidized-bed reactor for the same reaction and catalyst.

When Film Diffusion Controls

If film diffusion is a controlling factor, the diffusion rate will vary with the velocity of the gas stream past the pellets. If the flow conditions in the commercial reactor can be maintained exactly the same as those in the experimental reactor from which the rate data were obtained, this would not be a difficult problem.

However, this is not always the case. A commer-

cial fixed-bed tubular reactor may be operated at a much different linear gas velocity and may have a much different length-to-diameter ratio than the laboratory reactor.

Wherever possible, the experimental data should be obtained at conditions under which film diffusion is not a major factor. The commercial reactor, however, must be sized for the most economic conditions, even though these may not be in a flow range which is easiest to calculate. Therefore, in sizing a commercial reactor, some check calculations should be made to see if film diffusion is important at the proposed operating conditions.

How to Estimate Film Conductance

If the film diffusion rate is significant, we must evaluate the rate of mass transfer in the film. It is beyond the scope of this fundamental series to do more than mention that what we are after is a comparison of how quickly reactants are brought to the reaction centers, either at the surface of the catalyst or in its interstices, how quickly the reaction proceeds at the active center and how quickly products are conducted through the pores of the catalyst or through the film that surrounds the surface of the catalyst.

The calculations required for these comparisons involve a knowledge of mass-transfer operations and the use of correlations such as that proposed by Chilton & Colburn (Ind. & Eng. Chem., 26, p. 1,183):

$$j_D = \frac{k_g \ p_m \ M}{G} \left(\frac{u_f}{p_D}\right)^{2/3}$$

A typical correlation plot of j_D , the mass transfer factor vs. modified Reynolds number is shown above. Methods of calculations are presented in several textbooks, one of which is "Mass Transfer Operations," by R. E. Treybal, McGraw-Hill Book Co., New York (1955).

It is possible, then, to estimate the rate of mass transfer through the film to the surface of the catalyst at various places in the reactor. However, we must do this for each reactant and each product. And our calculations must be based on many not-too-sound assumptions,

Little wonder, then, that catalytic reactor design problems are usually solved in pilot plants with a pinch of chemical engineering and a handful of empiricism.

Next Month

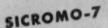
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Call on Timken Company metallurgists for understanding help in solving your tube steel problems. End uncertainty. Ask the experts? The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

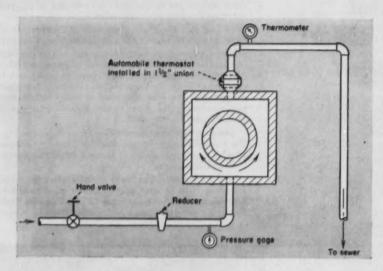


General view of the Timken Company metallographic laboratory where many analyses of steels are viewed under high-power microscopes.



SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

EDITED BY T. R. OLIVE



* Winner of June Contest

Auto Thermostat Controls Cooling Water

Here is an idea so simple that it has never occurred to most people. Next time you have a cooling problem, try it

J. Moziek

Operating Supervisor, Plastics Div., Monsanto Chem. Co., Springfield, Mass.

If you have a problem of maintaining a cooling-water jacket at a temperature in the range of 140-180 F., here is a very simple way to do it—buy an automobile thermostat!

In one of our processes it is necessary to maintain a 150 F. jacket cooling temperature. Only a very small amount of cooling water flow is necessary to do this. Consequently, available regulators were unsatisfactory because more water flow would be needed to make them function properly than could be tolerated. Other more elaborate controllers were costly and difficult to justify for this application, or were undesirable because of space limitations or complexity.

We solved the problem very simply by sealing the free-flow hole in the regulating disk of a 150-deg. automobile thermostat, and installing the thermostat in a bored-out standard pipe union. The union was then inserted into the water outlet line just above the jacket. We installed a

pressure reducing valve, pressure gage and filter in the water inlet line. Supplied with water pressure of 2-4 psi., the thermostat satisfactorily controlled the hopper water temperature at 150 F.

Operation of this temperature control is simple, fully automatic, reliable, and maintenance-free. The installation cost is small compared to any other type of controller and its use is indicated where simplicity, cost and space considerations are involved. Such thermostats come in standard automobile temperature ranges, but may be purchased also in special ranges.

Drain Pump Serves As an Agitator

Russell J. Love

Consulting Engineer, San Francisco, Calif.

It is not uncommon to use a centrifugal pump to agitate the contents of a tank or reaction vessel. However, here are some specific and useful pointers on the use of a pump in this way.

The same pump which is used to drain the tank can easily be hooked up to recirculate the liquid or slurry through the tank during a holding or reaction period. If there are solids in suspension, it is a good idea to use a cone-bottom tank. Install a by-

* Winner of July Contest-J. R. Wilson

"Flow Alarm Is Sensitive, Adjustable"

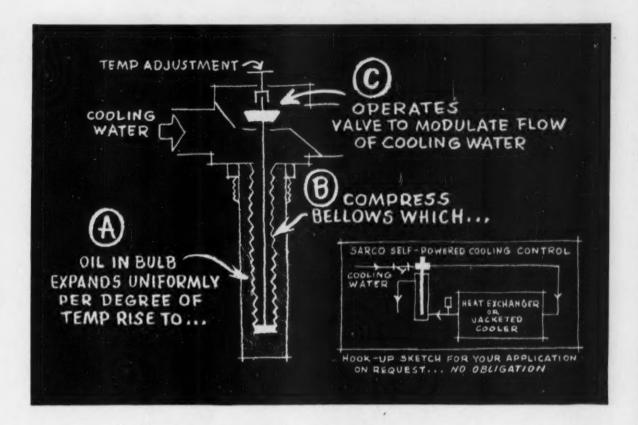
How Readers Can Win . . .

\$50 Prize for a Good Idea—Until further notice the Editors of Chemical Engineering will award \$50 cash each month to the author of the best short article received that month and accepted for the Plant Notebook.

Each month's winner will be announced in the issue of the second following month, and published the third following month.

\$100 Annual Prize—At the end of each year the monthly winners will be rejudged and the year's best winner awarded an additional \$100 prize. How to Enter Contest—Any reader (except McGraw-Hill employees) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates (\$10 min.).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, of interest to chemical engineers. Address Plant Notebook Editor, Chemical Engineering, 330 West 42nd St., New York 36, N. Y.



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service for firms such as Ingersoll-Rand, Butler Manufacturing Co., and Swift & Co.

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The low price makes it possible for you to use Sarco AUTOMATIC temperature controls for ALL control jobs, not just the big ones! For example, the 3/4" size costs only about \$39! Mail the coupon now.

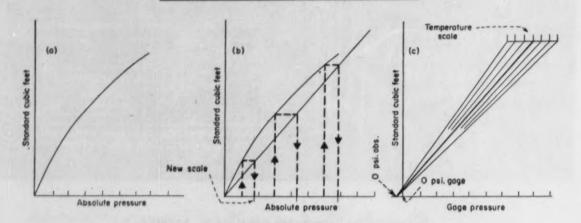
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pass line with a valve between the pump discharge line and a tangential recirculating nozzle in the side of the tank. This nozzle is best located according to the normal height of liquid in the tank. For dished- and cone-bottom tanks the nozzle height above the bottom of the straight side should be about one-quarter of the liquid height. For flat-bottom tanks with either a center or a side drain, this height should be increased to about one-third of the liquid depth.

Rather than to put separate valves in the bypass and discharge lines it may be preferred to install a three-port, two-way plug valve to simplify operation. However, in this case you may need a throttle valve to control the agitation.

Even if the tank can be drained by gravity it may be worth while to use a recycled tangential stream for agitation, rather than a conventional agitator, owing to improved accessibility and ease of maintenance, especially in closed vessels. Also, pump discharge will often be five to ten times faster than by gravity alone, which may be a determining factor.



Improved Capacity Chart for Gases in Storage Cylinders

Chesman A. Lee Engineer, Chicago, Ill.

A process concern with which I was once connected used large quantities of hydrogen gas brought in by cylinder trailer and stored at high pressure in banks of cylinders. Our problem was to be able to measure the quantity of compressed gas withdrawn from storage for use in the process.

For this purpose we had a large-face pressure gage and a thermometer, and we knew the volume of the cylinders. In addition, we had a chart of pressure vs. capacity at standard temperature, but it had large gaps throughout the working range, and straight-line interpolation was inaccurate.

Sufficient data were available in the literature (in this case the constants for the van der Waals equation) to permit drawing the chart accurately for any one temperature. However, there was quite a bit of curve-fitting required even for a single curve,

and this would have to be repeated for each of the separate temperature curves. Therefore, we adopted an expedient which greatly reduced the work of drawing the curves initially and also simplified the use of the final chart.

In the diagrams above (a) shows the first curve for capacity vs. pressure, plotted with uniformly divided scales for a single temperature. In diagram (b) a straight line has been added through the origin for constructing a new non-uniform scale for a straight capacity curve. The diagram shows how the points for the new non-uniform scale are found.

In order to add additional curves for each temperature it is now only necessary to add a temperature scale with points determined by the simple gas law. Straight lines drawn as at (c) through these points and the origin cover the desired temper-

ature range. The pressure scale is then shifted 14.7 psi, to read in gage pressure and is filled in to complete the chart.

This idea was originally worked out in constructing a vapor and partial pressure chart for myristic acid and was described in *Chem. & Met.*, Aug. 1936, p. 443. It should be of value wherever a family of curves is involved.

Preventing Corrosion in Air Preheaters

Alfred C. Friedland Chemical Engineer, The Palestine Electric Corp., Haifa, Israel.

Air preheaters used on large boilers are subject to blocking with fly ash carried by the flue gases. The gases also carry sulfur trioxide, vanadium pentoxide, iron sulfate and other materials which become strongly



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corrosive when the preheater is flushed down periodically to remove the dust deposits. The water becomes acid (pH 1-2) and may attack the preheater surfaces and drain pipes.

Our boilers, made by Combustion Engineering Corp., provide 450,000 lb. of steam per hr. at 1,300 psi. The air preheaters, which are of the Ljungstrom type, were originally washed down as recommended by the manufacturer with water made alkaline with strong caustic soda solution to a pH of 11. However, this method of protecting the metal of the preheaters had some serious disadvantages. Among these were the danger involved in handling the concentrated

caustic and the precipitation of iron hydroxide in voluminous quantity by reaction of the sulfate with the alkaline water. This added to the difficulty of cleaning.

In looking for a method of using fresh water to dissolve the deposits, or flush them out without adding new deposits, we discontinued the use of caustic and substituted for it a 0.2% solution of a pickling inhibitor. Laboratory tests showed that the loss in weight of steel immersed in the inhibited drain water is 97% less than without the added inhibitor. In addition, the new method saved the cost of caustic, reduced labor, and cut cleaning time by two-thirds.

Radioactive oil logging truck food from the second from the se

Tracers Find Brine Well Oil Pad

J. Kohl Chief Engineer, Tracerlab, Inc., Western Div., Richmond, Calif.

Many chemical plants use salt brine as a raw feed and obtain it by dissolving salt from underground salt domes. The well consists of a hole drilled into the dome and fitted with a casing and a central tube as in the lefthand sketch above. Since each well represents an investment of \$50,000 to \$200,000, it is important that a maximum of salt be dissolved from the dome around each well.

To produce large-diameter

instead of cavities slender cylinders as the salt dissolves out, it is common practice to float a pad of oil on top of the brine. The oil prevents solution of the salt from the top of the cavity. If the oil should leak up and out of the well, the dome cavity will move up, losing valuable salt. Also, as has happened in some cases, there may be land cave-ins with the loss of the well and other equipment in the vicinity.

Until the use of radioactivity techniques was introduced, there was no reliable method for locating the oil level. Gamma ray and neutron logs gave no conclusive results and operation generally proceeded on a calculate-and-pray basis.

Radioactive tracers are now used successfully for this purpose in the following way:

1. A base gamma-ray log of the well is made, using an ion chamber, Geiger-Mueller tube or scintillation detector.

2. An oil-soluble solution of a suitable gamma-emitting radio-isotope—for example, cobalt-60 naphthenate or antimony-124 tagged triphenyl stibene, both of which have been used with equal success.

3. The tracer solution is mixed with 100-200 bbl, of oil.

4. The tagged oil is pumped into the well through the annulus (or central pipe) and the injection system is flushed into the well with a quantity of non-radioactive oil.

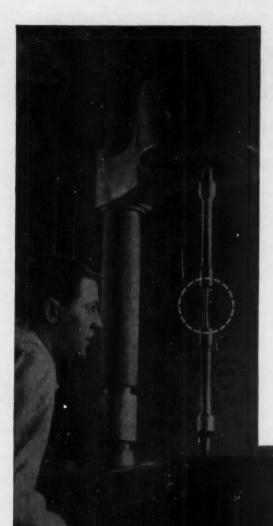
5. A gamma ray log of the well is made again and the oil pad position is located by the large response of the gamma detector when the oil pad level is reached.

Four wells of two different companies have now been checked successfully by this method using 10 and 20 mc. of Sb-124, and 12 and 6 mc. of Co-60, respectively. The amount of tracer to be used depends on the estimated cavity diameter at the oil level, and on the sensitivity of the gamma detector.

A typical log appears in the right-hand illustration. In this well it was expected that the oil pad would be found at 1,012 ft., but it was actually found at 888 ft.

The final log of this well was watched with considerable interest since the adjacent well had suffered a cave-in, resulting in the formation of a lake—and the pumphouse for the entire installation was located over the well being checked.

In addition to locating the oil level, this method has provided information of several other kinds including: (1) time required to mix tracers with oil as determined by dip counting (two days for a rectangular tank with



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FIG. 2475—Stainless Steel O.S.&Y. Globe Valve For 150 Pounds W.P.



FIG. 1559—150-Pound Steel Lubricated Plug Valve. Sizes



FIG. 3003—Steel Gate Valve For 300 Pounds W.S.P.



POWELL VALVES

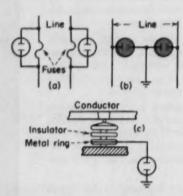
BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

a circulating pump; and (2) velocity of oil down the well, or amount of casing leakage. Here velocity is determined by moving the detector down the well a fixed distance and observing the

time required for the activity to traverse this distance. Leaks can be detected by noting the change in flow time when pumping at a fixed rate.

As these tests were carried

out, using proper precautions in handling the radioactive solution, no handling problems were experienced and no measureable radiation exposure was found by means of film badges.



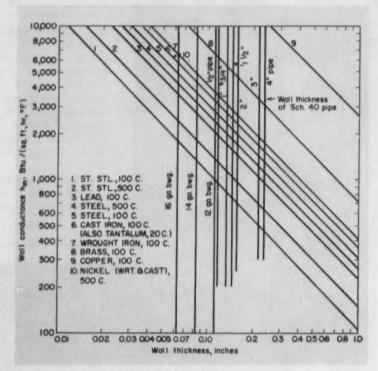
How to Use Neon Bulbs For Warning

Paul C. Ziemke Engineer, Oak Ridge, Tenn.

Simple little neon bulbs can often be used as tell-tales to show the condition of important circuits. For example, sketch (a) shows two neon sockets wired in parallel around individual fuses. Where there are several fuse cabinets it is often very helpful to be able to spot a blown fuse immediately. If a fuse lets go, the corresponding bulb will light up.

Sketch (b) shows how neon bulbs were used to indicate incipient insulation failure in an important signal circuit. Wired the way they are each bulb gets half the line voltage, but should the insulation of either leg of the power source begin to fail, then the lamp nearer the affected wire will dim, while the other will grow brighter.

Sketch (c) is a somewhat similar idea to warn of deterioration of fixed insulators such as porcelain, glass or plastic due to the presence of dust, fumes or exposure to prolonged dampness. The neon bulb is connected to a metal ring around the base of the insulator and to a relatively low resistance ground. It will glow long before deterioration is enough to result in arc-over.



Quick Check for Metal Wall Conductances

M. W. Shellenbarger

Engineering Dept., Hercules Powder Co., Wilmington, Del.

In the common expression for evaluating an over-all heat transfer coefficient U, taking into consideration the pipe wall and the film resistances, the wall conductance K/L may not be negligible, depending on its magnitude in comparison with the various film resistances such as h_{\circ} . The expression in question is:

$$U = \frac{1}{1/h_0 + 1/(K/L) + 1/h_i + 1/h_f}$$

The chart presented here gives a ready means of comparing the wall conductances of various metals and various wall thicknesses with the known film coefficients. For example, the wall conductance of a 2-in. ips. pipe of stainless steel at 300 C. will be about 840. Such a figure can be safely neglected if one or more of the film coefficients should be in the range of about 50 to 100.

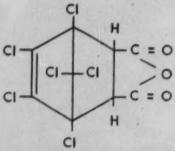
However, wall conductance would become relatively important if coupled with film coefficients of higher values.

Other values can be added to the chart by plotting two values of K/L vs L', the wall thickness in inches, and running a straight line through them.



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about HET® Anhydride, new intermediate .



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You can prepare both mono- and di-sodium salts easily by adding stoichiometric amounts of HET Anhydride to an NaOH solution.

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You can make mixed esters, as well as dimethyl, diethyl, dipropyl, etc.

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It contains .003% or less of sulfates. It has absolutely no free chlorine or arsenic, and has a mere .0002% of organic matter.

For requirements only a little less stiff, we recommend the Commercial Grade: sulfates, .003%; organic matter, .001%; chlorine, a slight trace; arsenic, none.

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- ☐ Sodium Tetrasulfide☐ Sulfuryl Chloride
- ☐ Thionyl Chloride

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EDITED BY H. T. SHARP



How to Get More Out of a Convention

Convention-going can be a waste of time or a source of new information, new ideas, new friends. A bit of planning makes the difference.

"Conventions are nothing but a monstrous waste of time and energy!"

That's the firm conviction of a good many convention-hard-ened executives and engineers. "Tax-free vacations," "energy sappers" and "time wasters" are among the milder terms they use to describe such meetings. And there's no question about it, they're right—at least they're partly right.

• We'll keep this discussion to the meetings of professionals. Motives for attending such affairs generally differ from those for going to conclaves of industry associations, dealer or sales meetings and trade shows. According to Fortune, businessmen go to these A lot of time is wasted at the typical business or professional convention,* even at those few considered "well run" by convention veterans. But it needn't be—at least you needn't squander your time.

A little preconvention planning can go a long way toward conserving those hours and making them yield a maximum return in information, contacts and enjoyment. Importantly, this planning

latter "for about the same reasons young ladies attend junior proms: to make contacts, to eye the competition and to avoid the bad public relations that attach to the absentee." Similarly, we'll omit political conventions from our considerations.

is easily done and takes only a few minutes.

Why Are You Going?

Planning for a convention starts with a clear statement of why you are going. Motives vary with the nature of the meeting and with a host of other factors.

Are you attending to hear a particular paper or symposium, to meet or question a speaker, to make new contacts, to renew old friendships, to exchange ideas on some problems, to get a new job or to take a break in the office or plant routine? Why you're going determines your schedule.

Firm's Practices Can Help

Unfortunately, to some engineers the question of why they're going is largely academic. Their firms simply send them on a

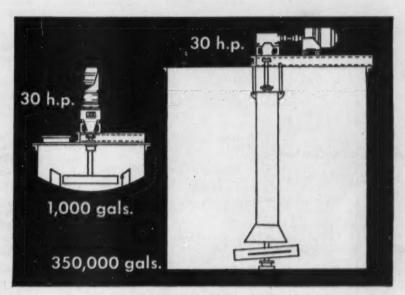




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When		in	Who	Where	What's Important		
0	Sept.	9-12	American Institute Chemical Engineers	Pittsburgh, Pa.	Symposia on mixing, distillation computation methods, scientific aids to management, explosions, unit operations in nuclear engineering		
0		10-12	American Society of Mechanical Engineers	Denver, Colo.			
		10-14	International Congress on Catalysis	Philadelphia, Pa.	Symposia on chemistry and physics of soli catalysts, homogeneous catalysis and relate effects, surface chemistry and its relation t catalysis, techniques and technology of catalysis		
		16-21	American Chemical Society	Atlantic City, N. J.			
		16-22	American Society for Testing Materials	Los Angeles, Calif.	Apparatus exhibit, symposia on plastics, titaniur radiation effects, radio-isotopes, fatigue		
		24-28	Atomic Industrial Forum	Chicago, III.	Trade Fair of the Atomic Industry and session management and technology for atom industry		
0		26-28	Chemical Market Research Assn.	Quebec City, Que.	"Canadian Chemical Economy"		
	Oct.	3-4	TAPPI	Appleton, Wis.	Plastics-paper conference		
		8-10	American Society of Mechanical Engineers- American Society of Lubricating Engineers	Atlantic City, N. J.	Lubrication of nuclear power equipment, hydr dynamic lubrication, boundary lubrication as lubricants		
		8-12	American Society for Metals	Cleveland, Ohio	Creep and recovery of metals, sessions dealir with uranium and nuclear activity, nucle reactor components, technical exhibit		
		15	The Salesman's Asso- ciation of the American Chemical Industry	New York, N. Y.	Chemical Sales Clinic		
0		22-26	National Safety Council	Chicago, III.	Safety in these industries: metals, petroleur pulp & paper, glass & ceramics, tanning & leath products, chemical, fertilizer, and rubber		
0		23	Association of Con- sulting Chemists & Chemical Engineers	New York, N. Y.			
0	Nov.	13-14	The Chemical Market Research Association	Boston, Mass.	New methods and techniques in market research		
		15-16	The National Association of Corrosion Engineers	Detroit, Mich.	Corrosion in these fields: automotive, utilitie chemicals, and construction		
		26-30	The American Society of Mechanical Engineers	New York, N. Y.	National Power Show, sessions of ASME nuclear engineering division, atomic energy industry conference		
0	Dec.	9-12	American Institute of Chemical Engineers	Boston, Mass.	Extraction of hydrocarbons for chemical us filtration, low temperature techniques, the sal engineer in chemical engineering		

rotating schedule, whoever's turn it is goes, whether the meeting is of prime interest to him or not.

This method assures the company of complete control over the number of men away at any one time, and it assures each engineer that he will get to a "fair" number of meetings. But it also leads to a large percentage of wasted time at the meeting.

Other firms add a welcome measure of choice by setting a formal or informal allotment for each man. They permit each engineer to go to an allotted number of meetings per year. His position and tenure determine the number.

Still others have an even more liberal policy, allowing their men to go whenever they choose, so long as their workload permits.

But whatever his company's policy on convention attendance, only the engineer himself can make convention-going profitable.

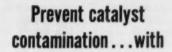
Organize Your Time

Key to making a convention pay off is the study you give to the program and other meeting aids.

Not merely a timetable, the program is the most readily available tool for organizing your convention time. When you read it to determine how and where you'll invest this time, keep several things in mind:

• Presence of a number of people with interests similar to yours is the most important feature of a convention.

 Addresses and papers of major importance will likely be printed. You can read an address



ALCOA TABULAR ALUMINA BALLS

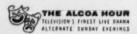
for bed supports or covers

Prevent catalyst contamination problems! Use ALCOA® Tabular Alumina Balls for bed supports or covers. Neutral, nonreactive and highly refractory, they keep contamination negligible.

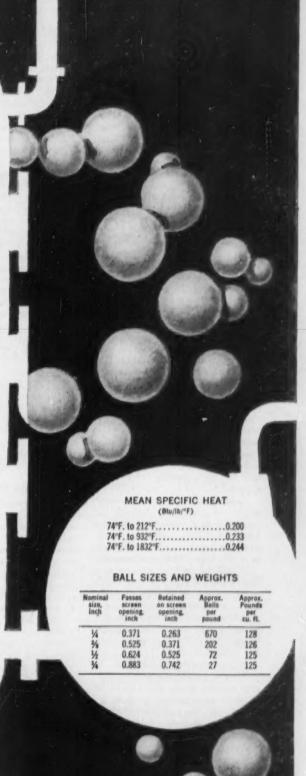
ALCOA Tabular Alumina Balls are high purity alumina in the sintered corundum form. Their chemical analysis is better than 99.5% Al₂O₃. Their softening point is well above 3500°F... and they are unaffected by oxidizing or reducing atmospheres at temperatures below their softening point. They are practically insoluble in all aqueous and alkaline solutions.

ALCOA Tabular Alumina Balls T-162 are available in ¼ inch, ¾ inch, ½ inch and ¾ inch diameters for use as catalyst and desiccant bed supports or covers where exposed to high temperatures, severe corrosive or erosive conditions. ALCOA Tabular Alumina Balls T-164 available in ¼ inch and ¾ inch diameters offer greater resistance to thermal and mechanical shock. They are suitable for pebble heaters and similar severe operations requiring high heat capacity and conductivity.

For more information and samples, write Aluminum Company of America, Chemicals Division, 702-J Alcoa Building, Pittsburgh 19, Pennsylvania.







or a symposium report in a fraction of the time it takes to hear it delivered (and you'll be more comfortable doing it).

comfortable doing it).

• Discussion of even important papers is not always

printed.

 Time-lag between delivery of the paper and its printing

may be appreciable.

In deciding whether to attend or pass up a particular session these may not be the most important factors, but they should be considered.

Let the Abstracts Help You

In addition to the program, abstracts and preprints of the meeting's papers may be available before the conclave.

Professional societies seems to be improving their abstracts as time goes on. But most convention-goers agree that there's still plenty of room for improvement.

Although higher standards are leading to better abstracts, the typical author still writes his abstract almost as an afterthought, not appreciating the fact that far more people will read the abstract than will hear the paper and that the abstract will help determine the size of his audience. A poorly-written, difficult-to-follow abstract is an efficient tool for discouraging interest in a paper.

Today's engineer must be wary when he uses an abstract to evaluate a paper's interest to him. That poorly written, hard-to-understand abstract may not be a guarantee that the paper itself will be poorly written and hard-to-understand—though it's often a good tip-off. Cloudy writing will usually only obscure what he wants to learn when the paper is read, even if the subject matter of the paper commands his attention.

When allotting your time, if you have to choose among several papers, given in concurrent sessions and of roughly equal interest, let the lucidity of their respective abstracts be a guide. Most of the time you'll choose correctly.

Make Use of Preprints

If you decide to attend a session, you'll probably get more out of it if you've seen preprints of the papers involved. Not enough

organizations make such material available. The American Petroleum Institute and the American Society of Mechanical Engineers (which preprints most of its technical papers but few nontechnical and general interest ones) are among those that do.

AIChE's monthly magazine, Chemical Engineering Progress, now publishes some of its more important meeting papers in issues just prior to the meeting. By giving members a chance to read the paper and prepare comments or questions for the author before convention-time, this practice serves about the same purpose as preprinting, but it is necessarily limited to relatively few papers.

Engineers often wonder why organizations don't make preprints available for study before the meeting, and then devote the meeting time to a discussion of the paper. By doing away with oral presentation of the papers. they contend, much time would be saved. The organizations generally agree that this would be fine, if it could be done, but it rarely works in practice. Biggest trouble is that many engineers don't find the time to read the preprint and then find themselves lost in the discussion.

Is a Session Worth Attending?

Many experienced engineers deliberately keep their attendance at convention sessions to a minimum and use the time for informal private conversations with new contacts and old friends. They judge a session worth attending only if it:

· Will yield specific answers

to a current problem.

Holds a paper of basic importance, one that will reveal significant new and useful information for the first time.

 Promises an intensive and stimulating discussion period with top men in the field participating. Will help them put the details of technical developments into perspective and relate these developments to important current or long-range problems.

If a session doesn't meet these standards in the light of the individual engineer's interests, he passes it up for a plant tour or a corridor discussion.

How to Get Acquainted

To a new-comer at a convention, getting to know people is always something of a problem. Paradoxically, it can even be more of a problem if he's there with friends or co-workers. Then he has to control the tendency to take the easy way out and retire into the protective shell of people he already knows and not bother making friends of the strangers he can meet there.

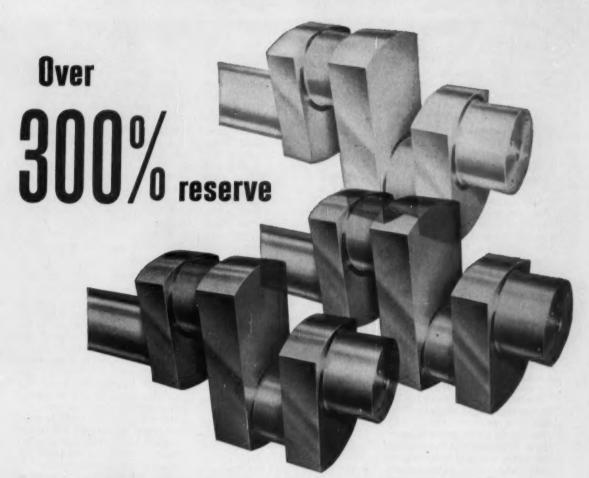
There are many ways for the relatively shy individual to break out of this shell and get to know people. One of the easiest is to start with the speakers. At a convention, these are among the easiest people to identify, approach and start a conversation with. Even before you meet a speaker you know something about him—his name, firm and where he's working—and something about the kind of work he's been doing. The convention program gives you all of this.

The subject the speaker covers in his paper is naturally good conversation fodder when you meet him. He's apt to be quite willing to discuss it with someone who's interested.

After they've participated in a session, speakers are usually available to answer private questions. But the confusion that surrounds the platform at this time is a real obstacle to trying to meet one of them. With several others impatiently bidding for his attention and his friends trying to lure him away to relaxing refreshment, your questions may get short shift.

Next Month: What Makes Men Worth \$100,000/Year?

Several dozen men in the chemical process industries earn \$100,000 or more per year. Other top men in industry earn over \$700,000 per year. You wouldn't be human if you didn't wonder what makes them worth so much to their companies. Next month, You and Your Job will take a look behind these pay checks at some of the men involved and the reasons they're so valuable.



Built in the Crankshafts of many Clark Balanced/Opposed Compressor Models

Extra-heavy crankshafts are standard equipment on Clark Balanced/Opposed compressors... it's brought about by standardization.

All models of a particular stroke size have the same bearing and crankshaft diameter. As an example, the number one crankpin of all CMA models is capable of transmitting with complete safety 600 BHP. The CMA-2 rated at 150-300 BHP and the CMA-4 rated at 350-500 BHP therefore have a tremendous reserve. The same thing applies to the 14" and 17" stroke CRA and CBA models.

Rugged shaft construction assures maximum bearing life and minimum maintenance. It also eliminates the need for a bearing between opposing cylinder crankthrows which would double the force couple between opposing cylinders and in turn increase shaft stress and foundation requirements.

Your nearest Clark representative will be pleased to give you all the facts on the original Balanced/Opposed compressors, or write for bulletin 118.

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CLARK 350 BHP BALANCED/ OPPOSED AIR COMPRESSOR



Balanced/Opposed Compressors Often its better to identify him at the session and then try to meet him later when he has a free moment.

There are plenty of other ways for the new-comer to meet people at a convention. One is to tell the convention committee that you're willing to share a room with someone else. Particularly at the larger meetings, hotel space is often short and you'd not only be doing the committee a favor but you'd also get a chance to make a friend. Another is to join a group on a tour of nearby plants when such tours are available.

But the best way to get acquainted with other engineers at a convention is also the simplest—just introduce yourself. Best times for making such contacts are at receptions and while waiting for sessions to begin. At these times especially there are a number of topics handy to keep the conversation rolling.

Incidentally, wearing the badge on the right lapel instead of the left is a practice that is just starting to catch on at conventions. Proponents of the practice claim that it makes introductions easier because the badge is more readily visible to the other person during the usual handshake.

Schedule Time for Relaxing

Convention-going is work. You can only sit through so many

papers or have so many conversations before you just stop listening. When planning what you'll do at a convention, remember that old saw: "The mind cannot absorb what the fanny cannot endure." Allow yourself time for rest and relaxation.

Generally, you'll eat more and sleep less at a convention than you do normally. Giving yourself time for some physical activity and some rest during the day will get rid of that loggy feeling and help you get more out of the sessions and discussions in which you take part.

Should You Take Your Wife?

Many professional conventions also schedule a program of activities for the conventioneer's spouse. Assuming she can go, will you get more out of the convention if you take your wife?

Perhaps. It depends on the nature of the meeting, why you're going and the sort of person your wife is.

Relatively few companies encourage their engineers to bring their wives to professional meetings, but most have no objection to her going. If you expect to be tied up in meetings and late discussions through most of the convention, it might be better if she passed this one up—unless she's the type that can keep herself busy in a relatively unfamiliar city and not drain your time.

On the other hand, if your interest in the meeting is limited to a few papers or discussions or so on, you might find it desirable to have her along. You wouldn't expect her to pave the way to important contacts like they do in movies, but she could handle personal details (write letters and cards, send out laundry, confirm reservations, etc.) or a few secretarial chores and still get in a short vacation while at the meeting.

Expenses* will average roughly \$20-25 per day more if your wife accompanies you.

Write It Down

You can boost the value of any meeting by jotting down a few notes on what you've learned there. Dictating a short memo to your file is often a good way to handle this. Naturally, it will include the names and addresses of the people you've met, important impressions from the various sessions and conversations in which you took part, etc. And while they're fresh in your mind you might note the things you did or didn't do that you feel could have helped to make the meeting more profitable.

The few minutes you spend at this can save you time later when you're hunting information and when you're planning your next convention jaunt.

* Not including shopping money.

SALARIES

. . . New Survey Coming

Another of the triennial salary surveys conducted by the Engineers Joint Council is now under way. Unlike most salary surveys, which solicit answers from individuals, EJC's questionnaire goes to the industrial and governmental organizations that employ engineering graduates and to faculty members of engineering colleges.

Replies by key personnel or administrative managers of the organizations together with the educators' answers will enable EJC to analyse the current salary structure for the profession. Findings will be published late this year in a booklet, "Professional Income of Engineers—1956," which you'll be able to get by writing EJC at 29 West 39th St., New York 18, N. Y.

GRADUATE STUDY

. . . Apply Now

Chemical engineers who plan to earn an advanced degree may qualify for the government's Fulbright scholarships and spend the 1957-58 academic year studying abroad.

Nov. 1, 1956, is the deadline for applying for the awards, which are open only to professional people at the predoctoral level who are not now engaged in college or university study. Applicants must also be U. S. citizens, hold a bachelor degree, be in good health and be able to savvy a foreign language well enough to study in its country. Applicants under 35 will be given preference.

The Fulbright program operates in 19 countries around the world and the awards cover transportation, tuition, books and maintenance for one academic year. If you're interested, you can get application blanks and a descriptive brochure from the Institute of International Education, 1 East 67th St., New York 21, N. Y. Requests for applications must be postmarked by October 25.



bines the advantages listed above with such other desirable properties as high thermal conductivity, freedom from metallic contamination, ease of fabrication and modification in the field, plus a complete technical advisory service. Literature furnished promptly on request.

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All measurement and control functions contained in just three basic units.

Each unit contained in a single, compact housing.

The transistorized electronic Controller has all control room components within one, panel-mounted case. Transistorized for highest reliability and compactness, this new instrument saves both panel space and wiring... means better process control for a smaller investment.

For transmission, control and valve operation based on the proved 'American-Microsen' System, be sure to visit

The J.S.A. Conference and Exhibit Manning, Maxwell & Moore Inc. Booths 404-409 New York Coliseum September 17-21, 1956

THE TRANSMITTER



The new Series 185 Pressure Transmitter is a miniaturized version of the well-known 'American-Microsen' Pressure Transmitter. It incorporates the latest mechanical and electrical features to achieve maximum operating benefits and usefulness.

The time-tested "Microsen" balance creates a stable dc signal for long distance transmission. Bearing pivots and linkages are entirely eliminated. Consequently, sensitivity is practically infinite, and repeatability of measurement is within 0.001% of range span.

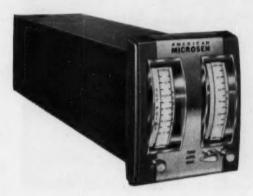
Printed circuitry and miniaturized components reduce the size of the transmitter to only 4%" in diameter and 5%" high. In dust and weatherproof case designed for universal mounting, the Series 185 can be firmly supported on meter piping, pipe pedestal or vertical surface.

'American-Microsen' Transmitters of similar design are available for differential pressure, flow, temperature and other variables.

MANNING,

MAKERS OF 'AMERICAN-MICROSEN'

THE CONTROLLER



The Series 164 Controller provides a complete controlling system in a single panel-mounted housing. Now one compact transistorized unit handles all control functions: indicating or recording the process variable, controlling, and manual-automatic operation. Transistorized design greatly improves reliability and service life. Savings in panel cost are tremendous because of miniaturization and consolidation of control functions — because no longer is it necessary to wire several units externally.

The Series 164 is available as a Recording Controller, compact Indicating Controller and as a long-scale Indicating Controller. Each functional unit is contained on a separate plug-in chassis within the housing. Each unit can be removed and replaced within moments without disturbing the operation of the other units.

THE OPERATOR



In 1955 we introduced the 'American-Microsen' Electro-Hydraulic Control Valve Operator — a power unit with position feedback to operate control valves, dampers, etc. It completely eliminated the need for compressed air.

More than a year of efficient performance in field service was paralleled by further engineering developments that culminated in the new Series 181 Electro-Hydraulic Control Valve Operator. This improved unit offers simplified design characteristics that mean even lower cost and greater reliability than its predecessor.

The Series 181 Electro-Hydraulic Control Valve Operator is mountable on standard yokes supplied with conventional slip-stem control valves with bodies of single or double-seated construction, with V-port, parabolic, needle and equal-percentage plugs. It can be furnished for all valve sizes, including those of 4" stroke, and with force available up to 3,250 lbs.

MAXWELL & MOORE, INC.

INDUSTRIAL CONTROLS DIVISION

Stratford, Connecticut

ELECTRONIC INSTRUMENTS FOR MEASUREMENT, TRANSMISSION AND CONTROL





1MPRESSED CURRENT applied to prevent corrosion on cold process lime-soda softener.

Controlling Corrosion in Water Systems

Cathodic protection has come of age in the past ten years as a method of corrosion control. Here's what you should know to help evaluate its use in your plant.

L. P. Sudrabin, Electro Rust-Proofing Corp., Belleville, N. J.

Costs of metal destruction have become so great that the use of properly adapted corrosion control measures cannot be neglected. For example, the direct costs of the corrosion on a traveling screen at a marine location may be as high as \$2,000 per year or the cost of each leak on a buried or submerged oil pipeline may exceed \$2,500

There are four basic methods of corrosion control by which the designer and/or operator can reduce such losses:

- 1. Corrosion resistant materials
 - 2. Protective coatings
- 3. Treatment of the environment
- 4. Cathodic protection
 Each of these basic methods
 has special adaptabilities and ad-

* Meet your author on page 392.

vantages—none is a cure-all method.

The cathodic protection principle—the application of a direct current to prevent or retard corrosion on a metal surface—has been used for over 130 years. The greatest advance in its use has occurred within the past ten years.

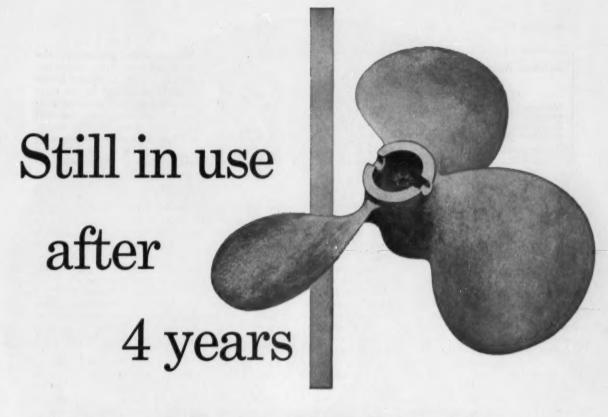
This advancement is attributable to the realization of the immense economic cost of corrosion, and to the development of materials and methods for applying protective current. In some instances, it is the one method by which the corrosion rate can be virtually reduced to zero.

In a recent API survey, onehalf of the reporting companies had more than 90% of their buried oil pipelines under cathodic protection. Among the water immersed structures to which cathodic protection is being applied effectively are water storage tanks; softening, clarification and filtration equipment; water boxes of surface condensers and coolers; traveling screens; sheet and "H" piling; crude and product tankers; barges; hot water generating and storage tanks.

Attempts to apply cathodic protection to steam generators, condenser and cooling tubes, and the internal surfaces of small diameter piping have fared poorly because of operating and geometrical conditions which influence the distribution of effect from any protective system of practical design.

Requirements to achieve corrosion control by cathodic protection are:

- 1. The corrosion system must respond to applied protective current.
- 2. Adequate protective current must be applied from an auxiliary anode within the electrolyte contacting the corroding surface. Partial protection is obtained from protective currents



in hot sulphuric acid and chlorides

PROBLEM Agitator propellors were failing at a rate of one every three months in dye kettles where hot sulphuric acid was mixed with chlorine-bearing organic chemicals. Sometimes corrosion was so severe that the propellors fell off the shaft and chipped the kettle lining. This required a major overhaul.

REMEDY Agitator shaft and propellor made of HASTELLOY alloy D were installed.

RESULT..... Four years later the same propellor and shaft made of HASTELLOY alloy D are still in service.

> HASTELLOY alloy D has excellent resistance to sulphuric acid in all concentrations and at temperatures up to the boiling point. In addition, it is resistant to many other acids and salts frequently used in solution with sulphuric acid. For a copy of a booklet describing HASTELLOY alloys, get in touch with the nearest Haynes Stellite Company office.



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Galvanic Anode Characteristics

Anode	Theoretical Amps, per Lb.	Nominal Eff.	Nominal Driving Voltage vs. Iron at -78 Volts*
Magnesium (H-1 alloy) Magnesium (Galvomag)	997	50%	0.7 v.
	997	50%	0.88 v.
Zinc (<0.0015% Fe)	382	90%	0.25 v.
Aluminum (3% Zn)	1,352	50%	0.2 to 0.25 v.

less than that which is needed for full protection.

3. The protective system must be maintained in operation.

Improper Use of Current

Among the nostrums sometimes imposed upon engineers are schemes and gadgets making improper or ineffectual use of electrical energy. Unobtainable claims are made for eliminating sludge, scale formation and corrosion problems. More than one engineer has demonstrated gullibility by buying the same gadget over again under a different name or a slight change in package.

Uhlig' suggests the following guide for evaluating vigorously promoted schemes: (1) beware of testimonials, (2) treat with caution any device which includes in its advertising literature statements obviously wrong, and (3) treat with caution devices that operate by no known scientific principles.

Welder and Partridge' have described the practical performance of several water conditioning gadgets, and the tactics that are used in promoting them.

Galvanic Corrosion

Galvanie corrosion is commonly viewed as consisting of dissimilar metals coupled together in a corroding electrolyte. We find such a system in a surface condenser, where the bronze tube sheet is coupled to the iron of the water box. The effect of this system is to cause corrosion of the iron water box (anode) and protection of the bronze tube sheet (cathode). The galvanic protective effect upon the bronze accompanied by corrosion of the iron has been described as "built in" cathodic protection.

Non-uniformities on the sur-

face of iron produce galvanic cells of intensity comparable to an iron-copper couple. Recent studies show that mill scale removed from the underlying iron, to eliminate the effects of the iron-mill scale couple, is more cathodic than copper in flowing sea water and requires more current for polarization.

The potential of rust scale taken from a diesel engine liner in Wichita, Kan. was +0.170 volts in fresh water and +0.170 to +0.240 volts in sea water (Harbor Island) measured against a sat. KC1 calomel reference electrode. The driving voltage between iron in an airfree environment at a pH of 9.0 and rust scale (magnetic iron oxide) exceeds one volt.

The iron-iron oxide couple has also been observed in a large diameter flume conveying water to a western city. An adherent rust scale formed on the top half surfaces, which were alternately submerged and then exposed to the moist atmosphere. Intense corrosion on the continuously submerged surfaces (anodic) and the precipitation of calcareous salts on the rust scale (cathodic) indicated the nature of the corrosion system.

Cathodic Protection

Corrosion of a metal submerged in water is an electrochemical process in which metal goes into solution at the more active surfaces, and an equivalent reduction process occurs on the more noble surfaces. These chemical processes are the cause of electrical current flow into the corroding electrolyte at the anode. The circuit is completed by the flow of current through the electrolyte into the cathode, and thence through the short circuit provided by the corroding metal.

In cathodic protection, the corroding metal is made the cathode to an auxiliary anode properly positioned in the common electrolyte. Corrosion control by cathodic protection will be complete when the superposition of the protective current effect upon the corrosion current flow at the anodic surface results in a net current flow of zero.

Protective Current Sources

The protective current may be provided by galvanic anodes coupled to the structure, or by current flow impressed upon auxiliary anodes from an outside power source. The protected surface does not recognize the source of the protective current. Thus, economics and practical operating conditions will determine the best protective system to use.

The driving voltage between galvanic anodes and the structure to be protected is determined by innate driving voltage of the metals used (see table). The amount of protective current applied can be regulated by the number, size (length and diameter) and the positioning of the anodes. Increasing the length of an anode results in nearly a linear increase in current output. An increase in diameter results in a much lower increase in current output (logarithmic function).

Impressed current anodes include sacrificial (consumed by the flow of current) and nonsacrificial anodes.

Among the sacrificial type of anodes used with impressed current are aluminum (17-ST) and iron. Aluminum is light in weight. The anodic product (aluminum hydroxide) is usually not objectionable, and an anode system in icing areas can be designed to last through the corroding season. A new set of anodes should be installed as soon as the ice has melted in a submerged structure. Iron anodes are being used less frequently.

Non-sacrificial anodes used include graphite, Duriron (14. 5% silicon cast iron) and platinum. Graphite and Duriron are used in individual lengths or are assembled in continuous

Better look into it!
THE NEW
DURCO



TYPE WALVE is now available!

Rolletin V /da

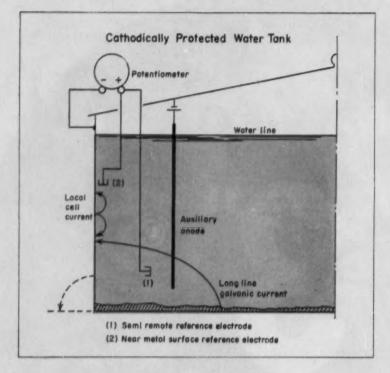


DURCO Type F valves are manufactured under one or more of the following patents. U. S. Patent Nos. 2713987, 2729420, 2735645, 2728550. Patented in Canada, 1955, No. 519424.



THE DURIRON COMPANY, INC., DAYTON, OHIO

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strings, with anode sections positioned at required locations on an insulated wire. In icing areas, such anodes are removed in the fall and reinstalled each spring.

Both of these materials are brittle. In some environments they tend to eventually disintegrate or be consumed by anodically formed gases which are not freely released (gas blocking action).

Platinum wires (#25 to #29 A.W.G.) have been used for several years. The high lineal resistance of such wires cause rapid attenuation of applied voltage along their length. Platinum clad rods are used for special applications where a few costly anodes can be justified (ship hulls, etc.).

The anodic product formed on non-sacrificial anodes will be O₂ or C1₂ in amounts electrochemically equivalent to the current flow. Chlorine will be formed in marine and saline waters; oxygen will tend to be formed in potable and low-chloride concentration waters.

Sources of impressed direct

Sources of impressed direct current commonly used are rectifiers and motor generators.

Applications

The early application efforts of the cathodic protection principle were to water-contacting surfaces—boilers, condensers, pumps, etc.

Such applications as these generally were not effective because of the complex structures and operating conditions.

Around 1925, the cathodic protection principle began to be used to protect buried pipelines. This application now is relied upon to preserve buried structures.

In 1935, cathodic protection was applied to the simpler geometric structure found in a water storage tank. Other applications have developed as the practice and understanding of the fundamentals have increased.

Water Storage Tanks

Cathodic protection has been applied to more than 15,000 water storage tanks following 1935.

Protective system consists of auxiliary anodes from which current is applied to the submerged tank surfaces. There is no one standard cathodic protection system design applicable to all tanks.

The applied protective currents vary from tank to tank and time to time, depending upon the water composition, the metal surface condition, temperature, velocity, etc. Protective current densities in water storage tanks may range from 0.1 to 20 ma./sq. ft. of submerged surface.

It has not been found practical to apply cathodic protection to uncoated tanks storing high resistivity condensate, because of the large protective current requirements and the high voltages required between the auxiliary anode system and the tank.

Corrosion in hot water storage and generating tanks is achieved by applying protective current from auxiliary anodes. Anodes are interposed between copper steam coils and the iron tanks to overcome the potential gradient between the dissimilar metals.

Some additional current is applied to overcome the local action current on the metal surface. To eliminate stray current effects from the applied current, the copper coils must be bonded to the tank shell.

Measurement of the protection achieved is discussed in the section on measurement of protection.

Water Treatment Equipment

Severe corrosion is experienced in water treating equipment used to flocculate, clarify, soften or filter water.

Pit penetration through steel plate in sludge blanket filtration, cold lime and soda softening equipment has been experienced within two years after construction. A cathodic protection system effectively controlling such corrosion is shown on p. 236.

In a midwest city, flocculators and clarifiers constructed in 1937 showed many areas of coating failure with intense pitting at the exposed metal surfaces.

In 1945, cost of proper surface preparation and re-coating would have been \$45,000. Cathodic protection installed for \$17,000 has since effectively con-



Only by a freak of fortune does the leaning tower of Pisa still stand. A faulty foundation was not apparent until the structure was three stories high. It is believed the architects were then forced to compensate by adding weight to the opposite side to save the building.

Are you building corrosion problems into your plant structures and equipment that will inevitably have to be compensated for by tremendous replacement costs? Many of these costs can be eliminated at the planning stage by taking advantage of the services of an expert in the field of corrosion resistant coatings...the Amercoat Sales Engineer.

The Amercoat Sales Engineer is trained in the principle that in corrosion engineering, too, foundations are all-important. You can put this factory-trained man on your staff, so to speak, without cost or obligation. His advice will be truly objective since it is based on a knowledge of all types of protective coatings and more than 43,000 case histories in our files. You can be sure that the Amercoat coating he recommends, whether vinyl, phenolic, epoxy or any other type, will be the right one for your job, and the most economical on the basis of cost per square foot per year.

Therefore, to effect important economies in specifying protective coatings you are cordially invited to call on your American Sales Engineer...right at the beginning. He will analyze all per-

tinent data concerning your corrosion problems based on our nearly 20 years of corrosion control experience, and give you a comprehensive recommendation. In addition to recommending the proper coatings, he will assist you in writing complete specifications. However, this is not the full extent of his service: he will also be available for consultation at the job site to insure proper application.

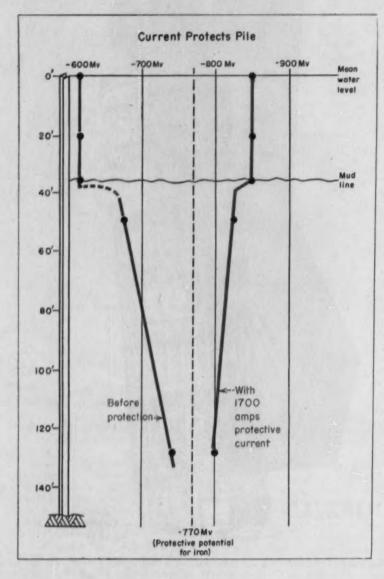
There are more than 70 Amercoat Sales Engineers and Distributors located throughout the country. It will pay you to talk to one of these men whether you are building a new plant or are interested in the efficient maintenance of existing facilities. The same service is available and equally important savings can be realized in both cases.

May we send you the name of the American man nearest you? Literature containing many helpful suggestions for the design and corrosion engineer is also available on request. Write to: American Corporation, 4809 Firestone Blvd., South Gate, Calif.

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trolled corrosion. (See cut, p. 244.)

Water Boxes

In power plants using brackish or sea water for cooling, the replacement of cast iron and steel water boxes of oil coolers and main condensers has been required within two years because of corrosion or graphitization.

Magnesium anodes attached to the water box heads have been effective in eliminating such corrosion.

The protective currents used range from 50-125 ma./sq. ft. of

calculated plane surface within the water box.

The protective effect from such an installation will not extend for a distance greater than one diameter into the tube entrance.

Magnesium or other galvanic anodes are consumed in the protective process and must be replaced. In instances where the cooler or main condenser must be maintained in continuous operation, impressed current from non-sacrificial anodes is used. A rectifier is used as the source of the applied protective current.

An inspection of one main condenser after more than six months of operation showed an alkaline calcareous deposit under the previously formed graphitization products.

Coatings have usually been inadequate to protect water boxes. A flaw in the coating exposes a small iron surface which is coupled to the large cathodic area of the tube sheet. Extremely intense pitting is then experienced.

Piles and Bulkheads

Major structures such as coal unloading docks, sheet piling bulkheads and condensing water intakes and flumes experience severe corrosion in brackish and sea water environments.

An example of pile attack occurring at various elevations in water and below the mud line (Edgewater, N. J.) reveals that the greatest penetration rate usually occurs just below mean low water.

Shown in the drawing is the pile to reference electrode potential at several elevations below the water line, before and after cathodic protection has been applied (Hoboken, N. J.). It is significant that in the unprotected system, the pile below the mudline is anodic to the pile in the water zone (protective potential for iron is -0.77 volts measured against a sat. KC1 calomel reference electrode).

Protective effect from auxiliary anodes submerged in the water zone is adequate 92 ft. below the mudline. These potential observations are particularly meaningful, since full protection is measured near the pile foot even though severe stray currents from a D.C. railroad exist in the area.

Cathodic protection is virtually the only method by which protection can be applied to existing piles below the water surface.

Development work is now underway to apply cathodic protection to reinforcing steel in concrete piles. To apply protective effects to such piles, all the steel must be bonded.

Ships and Barges

An unusually severe corrosion problem has developed in tankers carrying crude oils from the

The GPE Companies are leaders in that small, select group in American industry which is broadly qualified to develop and produce the systems needed today for defense and industry. GPE leadership accounts for some of the most advanced systems in use in business, television, aviation, marine, steel, oil, and other industrial fields.

In Systems Engineering, highly advanced capacities and resources are prerequisite. Yet, no matter how highly advanced, they are of little use if limited to a few areas. Finding optimum solutions to complex systems problems calls for balanced competences. And beyond that, success calls for the consistent application of such competences at every stage — beginning with research, and extending all the way through development, production and final testing.

No GPE company is limited by the boundaries of its own specialties. The basic GPE operating policy, GPE Coordinated Precision Technology, places at the command of each company in the group all GPE research, development and production facilities, and the skills and experience of the more than 2500 GPE technical men working in depth in the wide range of advanced capacities indicated in the chart above.

Behind each group working on a specific problem in one GPE company stands the whole group of GPE scientists, engineers and technicians with the answers — or the knowledge that will find the answers — to questions underlying and related to that problem. To the customers of GPE Companies this means that the concept and development of equipment, components and systems are not restricted or distorted by traditional allegiance to specific competences.

The five systems illustrated, while products of different GPE companies, are all examples of the consistent application of balanced competences, achieved through GPE coordination. For brochure describing GPE Coordinated Precision Technology and the work of the GPE Companies, or help on a specific problem, write: General Precision Equipment Corporation, 92 Gold Street, New York 38, N. Y.

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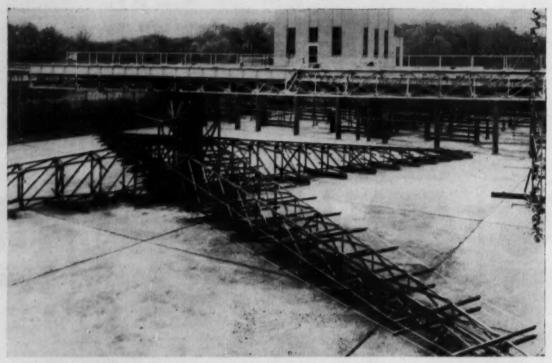
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IMPRESSED CURRENT applied to rake arms of clarifier and flocculation equipment.

Middle East. Pits on the horizontal surfaces progress at a rate up to 0.125 in./yr. The pH of the corrosion product in the pit may be as low as 2.0, even though the pH of the sea water used for ballast or of the layer of water separating from the crude oil cargo varies between 7.0 to 8.5. Intensity of pitting is related to the pH of the products within the pit.

Magnesium anodes are being used to virtually eliminate all such corrosion. Alkaline calcareous deposits (pH > 10.0) accumulate in the previously active

Magnesium and aluminum anodes are being attached to the hull of ships along the bilge keel line to effectively control corrosion. Impressed current systems with graphite, Duriron and platinum clad anodes—with controlled impressed current—are also in use for the protection of ship and barge hulls.

Steam Generators

Probably more effort has been directed to applying electrical methods to the problems of corrosion and scaling in steam generators than any other subject.

Results of these attempts have all been less than adequate."

Problems to be overcome in the cathodic protection of operating or laid-up boilers include:

1. Adequate protective current must be applied to all surfaces. This means that anodes would have to be centered along the length of each tube of a water tube boiler.

2. The anodic product should not affect the boiler water system. The anode products are (a) O, or Cl, evolved from nonsacrificial anodes or (b) magnesium ions from sacrificial anodes such as magnesium. The products formed at the anode are electrochemically equivalent to the current flow. In most systems, if one of these products cannot be tolerated, the other can. However, in the closed system within the boiler, oxidizing gases or metallic ions are both objectionable.

3. The high pressures and temperatures would require special insulated pressure fittings through the boiler drum.

4. Since the protective current

requirements vary from place to place and time to time, a means for regulating the protective effect must be established. The effects of cathodically produced alkalies and non-condensable gases on heat transfer surfaces must be established.

Methods of Measurement

The engineer must be assured that the method used to control corrosion is effective by some meaningful measure.

Dr. R. M. Burns has described the work of the corrosion engineer as the "task of preserving the metallic state in surroundings where variables are complex, compounded and uncontrolled."

This complexity of corrosion is illustrated by seemingly identical tanks in the same service, or the opposite halves of the same tank which do not experience identical corrosion problems. The performance and the requirements of any of the basic methods of corrosion control vary from place to place and time to time. For these reasons, evaluation of protective measures must be made of

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serves under certain conditons where higher temperatures prevail-up to 2700-2800°F.

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is even more refractory than the H-W SUPER CASTABLE and may be used at temperatures up to 3000°F.

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is a refractory concrete which is used with good economy for intermediate duty service, such as paving around furnaces, low and intermediate temperature flues, hot floors and similar applications.

H-W BAFFLE MIX—
is made with a coarse texture, which enhances its spalling resistance and other properties, especially desirable for use in monolithic baffles of boilers.

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combines the properties of light weight and heat insulation for use at temperatures up to 2450°F.

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weighs only 56 lbs. per cu.ft. Its thermal conductivity is about 38% that of highduty fireclay brick. In the class of lightweight castables, it is unusually strong and volume-stable within its temperature limit of approximately 2100°F.

H-W CHROME CASTABLE-

because of its density and chemical composition, is highly resistant to various corrosive fluxes and slags at high temperatures. An outstanding application is in bottoms and side walls of sodium salts recovery furnaces used in paper mills.

H-W STANDARD PLASTIC FIRE BRICK-

is manufactured from the highest quality of hard calcined flint and plastic bond clays. It is equivalent to high duty fireclay brick in refractoriness and is used successfully under most conditions for which fireclay brick of this class are adequate.

H-W SUPER PLASTIC FIRE BRICK-

is suitable for service requirements beyond the limits of standard plastic fire

PLASTIC THERMOLITH BATCH-

is a chrome refractory which is used to great advantage for the construction of furnace bottoms where the corrosive ash and alkaline fluxes is an important destructive factor.

OTHER TYPES: Among various specialized Harbison-Walker monolithic refractories is HARWACO MASTIC which is ideally suited for plastering with a trowel as for sealing V-shaped spaces at exterior faces of tubes of water wall boilers. Others include castables of low iron oxide content for particular catalytic requirements, and some having exceptional properties for certain exacting applications. These comprise ramming mixes in a wide range of chemical compositions

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the actual structures individually and by comparison of significant measurements at regular intervals.

▶ Protective Potential—Among the useful basic values is the protective potential of iron established by Schwerdtfeger and McDorman' to be -0.77 volts measured against a sat. KC1 calomel reference electrode. This is the open circuit potential of an iron electrode in an airfree environment at a pH of 9.0 (non-corroding).

Brown and Mears' show that cathodic protection is complete when the cathodes have been polarized to the open circuit potential of the anodes.

The author has shown that the cathodic polarization of any single corrosion current flow line is entitled to the IR drop through the electrolyte equivalent to the maximum distance of the trajectory of the current flow line normal to the corroding system. To control the short lines of corrosion current flow found in localized pitting (see dwg. p. 240), protective potential must be measured to a reference electrode 2 placed close to the metal surface. The longer lines of corrosion current flow (example: from the poorlyaerated bottom under silt to the well-aerated sidewall) will be controlled, if the protective potential is measured against a reference electrode 1 located farther from the cathode.

▶ Panel Tests—Prepared panels wherein dimensions, weight, surface preparation and material can be accurately established-are used in laboratory and field corrosion testing. Since environment variables can be controlled, carefully panel studies have been very useful in screening corrosion control methods in the laboratory.

Advantages of panel tests in-

1. Systematic screening of methods. (Inhibitors, materials, applied current densities, etc.)

2. Quantitative measure of weight and dimension loss with time are easily made.

3. Variables in the environment and control methods can be regulated.

There are some limitations in interpreting results of panel

tests made in the laboratory or made within an operating struc-

1. Surface condition of the panel and protected structure surfaces are not alike (example: sandblasted panels are usually anodic to the structure).

2. Effects of working stresses are not produced on panels.

3. Sweating and condensation conditions are not easily reproduced on panel.

4. Incidental areas of pitting would be difficult to reproduce.

5. Short time studies on panels cannot always be extrapolated into anticipated longterm results.

6. Position of the test panel in the protected structure will affect the amount of protective current received.

► Non-Destructive There are techniques presently in use for ultrasonic metal thickness testing. One type of equipment employs a variable frequency oscillator that is tuned until a standing wave of sound energy is set up. Frequency and wave length are related to the sound velocity, and the thickness of material can be determined when the frequency is such that resonance is established. Scale or oil film on the opposite side of the steel plate is not included in the thickness measurement.

One procedure to evaluate the corrosion rate in tankers is by annual surveys consisting of some 500 thickness measurements throughout the ship. Test locations are prepared by cleaning the metal surface and sanding it flat to accommodate the transducer head on the Audigage. This surface preparation and failure to repeat tests at precisely the same location on subsequent surveys limit the significance of the measure-

A practice of Electro Rust-Proofing Corp., in measuring the effectiveness of cathodic protection on a surface, is to prepare a permanent baseline surface on the opposite side of the bulkhead-on the deck, hull or member. The permanent baseline and transducer head location is protected by painting and a neoprene pad. Although fewer thickness measurements (6 to 12 per tank) are made, they include all

the factors influencing the protected system.

▶ Plaster Cast-Progress of attack in individual pits on bottom plates in crude service may be shown by plaster of paris contours made on annual resurvevs.

In the first investigations, casts were matched at high surfaces and the difference in contour represented the progression of attack. More recent practice is to weld two Monel pins to the bottom to provide a baseline for locating the test section, and for measurement of the progress of the pit. Monel welded to iron is protected from sea water corrosion by galvanic effect.

> pH of Product in Pits-Decreasing pH of products in pits indicates increasing rates of pit penetration. A pit product of pH 2.0 indicates a pitting rate of 0.100 to 0.150 in./yr. Deposition of calcareous salts or a pH above 9.0 in formerly active pits indicate that the corrosion rate is virtually zero.

Conclusions

Cathodic protection has come of age in the past ten years as a method of corrosion control on underwater surfaces.

Requirements for effective corrosion control are:

1. The corroding system must respond to the application of protective current.

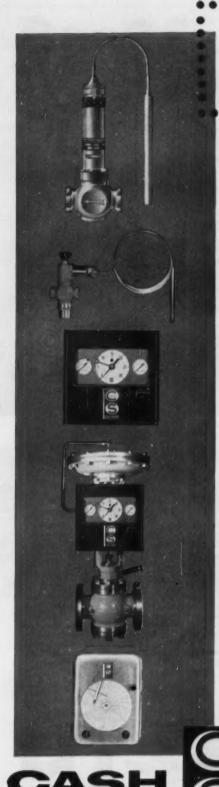
2. Adequate protective current must be properly distributed over the submerged surfaces.

3. An engineering design must be made in which the materials used are compatible with the operating conditions and the water quality requirements.

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This article is based on a paper presented at the American Power Conference, Chicago, Mar. 21-23, 1956.



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Feature a liquid filled thermal system for high operating power and uniform throttling action and has built-in over-load protection. Available in 50° F. and 100° F. ranges from 25° to 325° F. Direct and reverse acting units $\frac{1}{4}$ " to $1\frac{1}{2}$ " with screwed ends, and 2" to 4" with flanged ends. Bulletin No. 500. (Cash Standard Stacon Corp.)

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An air operated, mercury actuated proportional temperature controller, Temperature ranges from -40°F. to 1000°F. Calibrated set point adjustment, unit construction, air relay with sapphire orifice and push button cleaner, feedback type proportional control with 1-100% band and differential gap. Also available with 1-150% proportional band combined with automatic reset action. Bulletin No. 978. (A. W. Cash Co.)

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An air operated temperature controller with mercury, vapor, gas or organic liquid actuation. Temperature ranges from $-350\,^{\circ}\text{F}$, to $1200\,^{\circ}\text{F}$. Available in 9" and 12" case size, spring or electric driven chart drive, on-off control or 1-100% proportional control.

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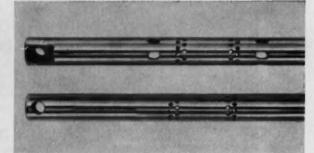
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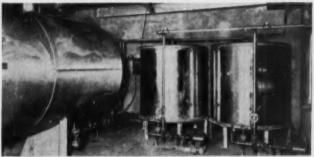


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CORROSION-RESISTANT PIPING SYSTEM is provided by Republic ENDURO Stainless Steel Pipe. Here it is used to distribute acetic acid from bulk storage in a textile mill. ENDURO Stainless Steel Pipe stubbornly resists rust and corrosion. Resists the action of most alkalies and acids. The slight additional cost of this long-testing pipe is an inexpensive investment in long-range economy. Send coupon for more information.

STEEL and Steel Producto The 20-foot stainless steel carpet reel, shown at left, easily supports 19 men weighing over 3,000 pounds with only a fraction of an inch deflection.

But of more importance to the textile industry, the reel supports, lifts and winds huge pieces of heavy, wet carpeting 18' wide and 120' long, during dyeing operations.

Old-style reels made of other materials could not meet the high strength and corrosion-resistance demanded in today's modern dyeing procedures. Roll engineers of the Rodney Hunt Machine Co., Orange, Mass., solved this problem by utilizing the advantages of ENDURO Stainless Steel in developing the patented Girder Type reel.

The exceptionally high strength-to-weight ratio and corrosion-resistance of stainless steel permits the use of thinner, lighter sections without loss of strength. In the new Rodney Hunt design, internal supports made from solid stainless steel sheet, together with a redesigned central girder have resulted in a reel with 35 times the stiffness of the old type.

Reels made from ENDURO have also solved the problem of contamination and dye carryover caused by other materials of construction. ENDURO Stainless Steel is non-contaminating. It's easily cleaned with a water rinse. It's solid stainless steel all the way through with no applied surface to chip, flake or peel—never any danger of snagging fabrics.

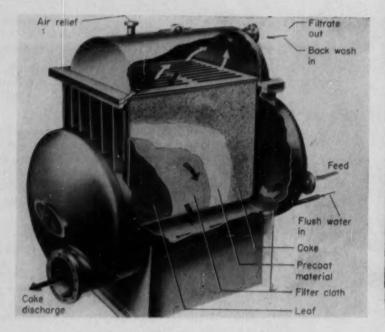
ENDURO-made textile equipment lasts and lasts. While its initial cost may be somewhat higher than less resistant materials, immediate savings in maintenance costs, less down-time for cleaning, and longer service life soon cancel out extra cost and then result in savings.

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Process Equipment News

EDITED BY C, S, CRONAN





Pressure Tank Filter Doubles Capacity

New pressure-leaf filter clarifies water at twice the rate normally expected. Low installation and operating costs are reported.

When you can operate alongside conventional units and show a two- to three-fold gain most people will grant that you've made noteworthy progreas. Such is the operating record revealed recently to substantiate the new Hi-Rate pressure filter's claim to superiority of performance in the field of water filtration.

Filtration tests on oil-field brine by Richfield Oil Corp. at Russell Ranch in Central Cuyama Valley, Calif. produced rates up to 1.5 gpm. per sq. ft., according to the Oil & Gas Journal.

Over a 20-hr. test, the filter operated at an average rate of 1.39 gpm. per sq. ft. The accepted rate with conventional diatomaceous earth and stone

filters is in the range of 0.5 gpm. per sq. ft.

Total cost for clarifying water with the Hi-Rate filter, based on a 10-yr. life, is estimated to be 1.3 mils per bbl. at the 1.39 gpm. rate.

▶ Unrestricted Upflow—Inherent in the Hi-Rate filter is unrestricted upward flow of filtrate. Any entrained gases are vented so that they cannot form air pockets that might reduce flow.

Rectangular filter leaves are suspended from a slotted plate within a closed tank which is surmounted by a dome. The slotted plate separates the feed compartment of the filter from the dome.

Water enters at the bottom of the tank, passes through the leaves depositing solids on the precoated surface, and flows upward within the leaves to the dome. Filtered water discharges through a filtrate port which is located near the top of the dome.

Any entrained air or gases which rise into the dome are bled off through a relief port. Venting of air not only prevents loss of filter area, but also assures that the upper portion of the leaves will be precoated properly.

Backwash Cleaning — When the filtrate cycle is completed, the flow is reversed to backwash the leaves. Clarified water in the dome flushes back through the slots and filter media to sluice the filter cake onto the sloping bottom of the tank and thence to waste.

Usually, the water remaining in the dome after filtration is sufficient to remove the solids completely from the leaves. And the backwash principle eliminates need for sluice noz-

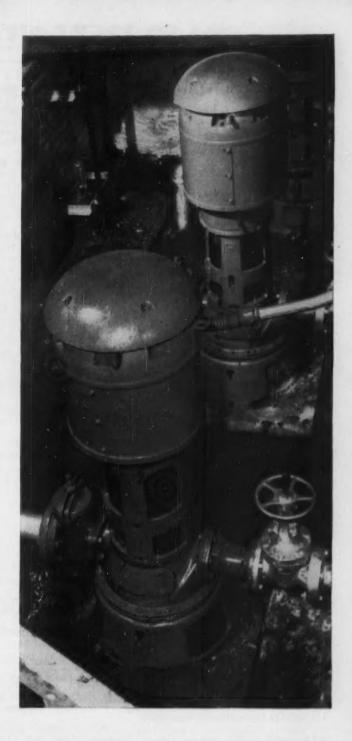
17 pump-years of service at \$152 per month for repair parts

The three Type G LaBour pumps in this picture have delivered a total of seventeen years of service to the Sharon Steel Corporation, Sharon, Pa. The first pump was installed in 1948, the second in 1949, and the third in 1953. The pumps are handling pickling solutions at 100° to 120° F.

Sharon Steel Corporation has purchased \$930 worth of parts for these pumps, some of which were spare parts not for immediate use. Counting them all, however, it figures only \$18.25 per pump per year of service.

Since fewer part replacements are required, the true saving made possible by LaBour pumps is greater than the mere comparison of parts cost. Usually the labor and down-time are more costly by far than the parts themselves.

If you're after real economy in pumping corrosive liquids, you'd better look at LaBour. When all the figures are in—first cost and maintenance total—after years of service, LaBour is the bargain pump of the field.



LABOUR



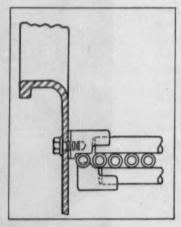
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zles and in other moving parts. > Wide Choice of Precoats—Many different precoat materials can be used with this unit. On the Richfield job, mentioned previously, a layer of wood pulp topped with diatomaceous earth cost only 28% as much as the usual asbestos-diatomaceous earth precoat. The wood pulp was found to adhere well to the Saran filter cloth, yet release easily when backwashed.

Single-Point Control—Each step of the operating cycle—precoating, filtration and backwashing—is regulated closely through a single-point, remote control system. The operator merely rotates a control wheel in the clockwise direction to actuate hydraulically controlled valves. This system is reported to prevent improper sequencing of the cycle.

Hi-Rate filter systems are furnished complete, ready to operate. User has only to connect the four inlet and discharge ports and the electrical service. At present, only a 310 sq. ft. size is available.—Dorr-Oliver, Inc., Barry Place, Stamford, Conn. 250A



Distillation Tray

Made with glass using the Turbogrid design.

Advantages of glassed steel construction for processing now are available in a column with specially constructed Turbogrid trays. With the new design, the problem of supporting a glass tray in an all-glassed tower has been overcome.

Trays are supported inside a glass-lined column by bolting glassed Inconel cups to the column sidewalls. Teflon-sheathed gaskets are used for sealing.

The cups hold four extraheavy Pyrex brand support tubes, each encased in a Teflon or polyethylene shield to prevent wear of glass on glass.

Small Pyrex brand tubes are laid across the supporting members. These small tubes are held in position by Teflon or polyethylene spacers and by

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Avg. of all	201.3	204.2
Process Industries		
Cement mfg	192.5 201.9 187.0 190.7 194.3 194.6 198.3 200.8 198.4	194.8 204.3 189.2 193.0 196.6 196.9 200.7 203.2 201.4
Related Industries		
Elec. power equip Mining, milling Refrigerating Steam power	203.8 203.2 224.9 190.2	206.2 205.6 229.0 192.5

Compiled quarterly by Marshall and Stevens, Inc. of III., Chicago, for 47 different industries. See Chem. Eng., Nev. 1947, pp. 124-6 for method of obtaining Index numbers; March 1956, pp. 194-5 for annual averages since 1913.

CENTRIFUGAL COMPRESSORS

cover practically <u>all</u>
of your
process requirements

MULTI-STAGE
VERTICALLY-SPLIT
Capacities to 9,000 cfm

Capacities to 9,000 cfm Pressures to 2,200 psi

> 2. MULTI-STAGE HORIZONTALLY-SPLIT Capacities to 165,000 cfm Pressures to 625 psi

Here are the three basic types of Ingersoll-Rand centrifugal air and gas compressors. The complete range of sizes available in each type provides extremely wide latitude to meet process conditions. By combining two or more individual units of the same or different types in tandem or in series, a great range of capacities and pressures are obtainable (units up to 2,000 psi have been furnished).

Any type of drive can be used and combination units can be individually powered or driven from a single source—electric motor, steam turbine or gas turbine. This flexibility of application is one reason why more and more I-R centrifugals are being installed in all types of process service.

Ingersoll-Rand has supplied more horsepower of industrial centrifugal compressors and Turbo-Blowers than any other manufacturer. This long experience means greater dependability, higher sustained efficiency and less maintenance expense. If you have a process compression problem, call in your I-R engineer. His experience in this specialized field can save you time, effort

用

Typical series combination of three multi-stage horizontally split centrifugal compressors mounted on a single base and arranged for a common drive.

Capacities to 255,000 cfm Pressures to 1,000 psi

SINGLE-STAGE



11 Broadway, New York 4, N. T.

stream operation.

and expense from initial planning to on-

another extra-heavy sheathed Pyrex branch tube lying across them.

Plastic plugs protect the ends of all tubes. Tray assemblies usually are inserted in the columns with their tubes at right angles to each other. The round Pyrex brand bars provide a maximum exposure of gas to liquid.—Pfaudler Co., 1011 West Ave., Rochester, N. Y.

Gas Generator

Compact, low-cost unit to produce oxygen-free atmosphere.

252A

A new gas generator produces oxygen-free atmosphere to protect products from deterioration and spoilage during bulk storage, dehydration, drying, shipping or packing.

An exclusive control device assures more constant and efficient combustion. Flow of fuel into an air-fuel mixer is governed through a fixed orifice with two pressure regulators arranged in series. Adjustment is made by changing the presure above the orifice.

This method of control eliminates supply line fluctuations and provides more positive regulation of the fuel than possible with ordinary throttling valves. An air temperature controller maintains a constant air temperature and also furnishes a constant weight of air to the burner.—W. F. & John Barnes Co., Food & Container Section, 301 South Water St., Rockford, Ill.



Pellets Enter Furnace in Minerals Laboratory

Pelletized mineral fines enter travelling-grate furnace during pyrometallurgical operation at the new Dwight-Lloyd Research laboratory. Available to basic industries, facility is designed to develop engineering data covering size enlargement techniques in materials fields such as iron ore and its concentrates, other metallic ores, raw cement meal, clays and shales, coal

wastes, limestone, flyash and other non-metallics. Equipment is available to crush, size and screen, pelletize, heat harden, sinter, blend, dry, calcine, etc. Prime project now in full swing is conversion of flyash into lightweight aggregate for building and other purposes. — Dwight-Lloyd Research Laboratory, McDowell Co., Inc., 16300 Waterloo Rd., Cleveland, Ohio. 254B

For More Information...



about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.

Drum Dryer

Handles solids formerly dried on tray dryers, is easy to clean.

Feeds ranging from pasty or doughy mixes to distinctly granular solids are dried equally well by the Drumulator.

Material is dried in space between a heated drum and continuous belt. Entering at one end of the drum, the material makes a series of revolutions with the drum. After making approximately § of a revolution it is plowed off and again fed to the drum. It advances across the drum face a fraction of an inch with each revolution.

Repeated plowing agitates and mixes the solids to improve release of moisture—The Jeffrey Mfg. Co., Columbus 16, Ohio. 254C

Continuous Mixer

For solids up to $1\frac{1}{2}$ in., either dry or slurried.

The new Gasmaco line of continuous mixers and pug mills can be furnished as part of a system complete with bins, buckets, elevators, conveyors, etc., if such is required. Mixers will handle any size material from dust to 1½ in., either dry or in a slurry.

Mixer features an all-welded frame of heavy steel plate; standard replaceable mixer trough of heavy gage sheets; box-type construction that prevents catching dirt; safety guard over mixing portion of trough; diversion plate at discharge to eliminate segregation; and highest quality drive with expansion-type roller bearings to support the shaft.

—The Gas Machinery Co., 16100 Waterloo Rd., Cleveland 10,

Even hard-to-dry, heat-sensitive chemicals are easy to process

with Glascote conical, rotary DRYER-BLENDERS

These glass-lined vessels assure freedom from contamination . . flexibility of use . . . shorter drying cycles . . . uniformity of product . . . elimination of handling and sticking losses

GLASCOTE conical, rotating Dryer-Blenders give you speed, ease and efficiency for drying and blending a broad range of corrosive and heatsensitive materials, using either steam or hot water.

As the dryer rotates, it imparts a tumbling action that results in continuous, uniform drying and blending of the material. Non-corrosive, glasslining assures product purity. Ease of handling and non-sticking properties of the glass-lining reduce product losses.

Glascote Dryer-Blenders are ideally suited for handling heat-sensitive materials. By using hot water in the jacket, very low drying temperatures can be obtained. Continuous exposure of new surface shortens drying cycle and prevents overdrying and caking of material.

Standard glass-lined Dryer-Blenders are built in the following capacities — 5 to 35 cu. ft. and larger on request; operating temperatures — liner 500° F, Jacket 650° F; operating pressures — tank full vacuum to 25 psi, jacket 65-75 psi (50-60 psi with tank at full vacuum). Acid or acid-alkali glass-linings are available. Complete specifications available on request.

Our standard one year guarantee continues to apply to all Glascote glass-lined products.



CLEVELAND 17, OHIO

Sales Offices or agents located in
New York • Philadelphia • Union, N. J. • Chicago • Cleveland
Dayton • Houston • Los Angeles • Toronto • Montreal
Export Sales: A. O. Smith Corp., International Division, Milwaukee 1, Wis

Installed at the Chicago Heights, Ill., plant of the

Installed at the Chicago Heights, Ill., plant of the Victor Chemical Works, this Glascote conical, rotary Dryer-Blender makes possible uniform, short-cycle drying of several materials which couldn't be dried in any other way.

Ask the representative who coils on you for all the facts about Glascote products — reactors, receivers, condensers, columns, storage tanks and accessory products. Or, if you prefer, write direct. Blascote Products, Inc., Cleveland 17, a subsidiary of A. O. Smith Corporation.

A subsidiary of A.O.Smith Corporation

World's largest manufacturer of glass-lined steel products





Valve Coupling

Automatically stops flow when line is uncoupled.

Employing a new principle, the new fail-proof, leak-proof Dubl-Safe valve coupling can be used both as a hand valve and quick-coupler.

Device consists of a primary valve within a secondary valve. First to open and last to close, the primary valve serves as a safety device for the main valve.

As the two members engage, O-rings seal the connection before the two poppet valves and the main piston valves open. In breaking out, the main piston valve seals off the line flow which reduces pressure within the valve. The poppet valves seal residual fluid in the valve bodies. In addition, each joint is sealed by the O-rings.—Harbison-Fischer Mfg. Co., P. O. Box 127, Fort Worth, Tex.

Nylon Pipe

Extends pressure and temperature range for plastic pipe.

Just announced is Tempertube nylon pipe—reported to be the first plastic pipe able to convey liquids over the full range of temperatures and pressures encountered in the main piping applications.

Compared with other pipe of comparable dimensions, Tempertube provides greater bursting strength and ability to withstand higher temperatures than any other plastic, is priced competitive with copper, is nontoxic, and assembles easily with commercial fittings.

Available in straight lengths or continuous coils, Tempertube varies from # to 1 min. O.D. with wall thickness from 0.025 to 0.125 in.—The Danielson Mfg. Co., Danielson, Conn. 256B

Storage Valve

For high-pressure shutoff, opened instantaneously by explosion.

A new, exclusive shutoff valve for service on high-pressure storage of gas or liquid operates instantaneously when a small, completely contained explosive squib is fired.

When this happens, an unobstructed flow passage opens from inlet to outlet within 0.002 sec. A ram moves forward to shear out the sealing diaphragm in one piece. Products of combustion from the explosion are completely sealed within the chamber to prevent any possible system contamination.

Size of the flow passage is equivalent to a \$\mathscr{g}\$-in. orifice. Only \(\frac{1}{2}\) amp. is required to fire the explosive squib. Maximum operating pressure is 5,000 psi.

—Explosive Products Div., Conax Corp., 7811 Sheridan Dr., Buffalo 21, N. Y. 256C

Exhaust Fans

For corrosive service, fabricated of resin-bonded glass fiber.

A complete line of exhaust fans, engineered by experienced fan personnel and fabricated of resin-bonded glass fiber, now is available in the United States. Line complements manufacturer's corrosion-resistant ventilation duct work.

These centrifugal fans are designed so that no metal parts are exposed to the corrosive vapors. Fan casing is made entirely of resin-bonded glass fiber. Steel fan blades are carefully balanced, covered with resin-bonded glass fiber and rebalanced before assembly.

Polyester resin used in construction has inherent fire resistance as well as resistance to corrosion. Where an even greater range of corrosion resistance is needed, fan can be fabricated with epoxy resin.

Standard sizes range from 6 to 24-in. inlet.—duVerre, Inc., 374 Delaware Ave., Buffalo 2, N. Y. 256D



Piping Compensator

Permits movement in system, compensates for strains.

An entirely new piping compensator takes care of all strains in steam, air, hydraulic and refrigeration pipe lines.

Unit consists of two ball seats which are spring-seated individually so that movement is possible in all directions, including unlimited traverse expansion. All internal parts are corrosion resistant and fitted with seals that will not adhere to the metal.

Compensators come in sizes from ½ to 6-in. dia., to any suitable length.—Rotherm Engineering Co., Inc., 7280 West Devon Ave., Chicago 31, III.

Ducts, hoods and fittings of polyester, glass-reinforced plastic now available in standard shapes and sizes as well as custom built. Initial installation and maintenance costs substantially lower than for other materials with comparable corrosion resistance. — Haveg Industries, Inc., 900 Greenback Rd., Wilmington, Del. 256F

Condensate return pumps for closed low-pressure heating systems or process equipment, and for boiler feed condensate return have been announced in single or duplex construction.—Goulds Pumps, Inc., Seneca Falls, N. Y. 256G



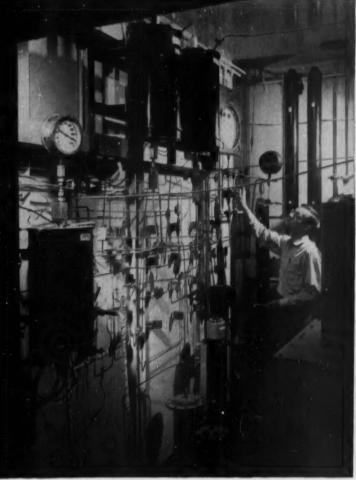
A CONSTANT SEARCH for new and better catalysts is carried out by Girdler's Research and Development Service. Typical of the work of this branch is the constant testing (above) for the proper balance between physical strength and activity of catalysts.



WHAT'S YOUR PROBLEM 7 There's a large staff of technical personnel at Girdler to provide valuable Catalyst Application Service. Girdler men work closely with customers—at their plants—helping them get the best possible results from Girdler Catalysts.



TROUBLE-SHOOTING is a major responsibility of Girdler's Analytical Service. Here, advanced analytical techniques (like this ultra-violet spectrophotometer with flame attachment) are used to solve problems encountered by customers.



NEW FRONTIERS—new products and new markets are developed for Girdler customers through our Market Research Service and the improved catalysts this branch helps develop. Girdler's search into future market possibilities is a good example of the wide scope and many economic advantages that Girdler's full-scope service means to you. Write on your company letterhead for free copy of booklet "Girdler Catalyst Facilities."

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LOUISVILLE 1, KENTUCKY

GAS PROCESSES DIVISION: New York, San Francisco VOTATOR DIVISION: New York • Atlanta • Chicago • San Francisco
In Canada: Girdlar Corporation of Canada Limited, Toronto

Cleaning Rod

For the inside of liquidlevel gages.

A new and practical cleaning rod fills a long-existent need for a device to really clean the inside of gage glasses. Key to success is a cloth swab on the end of the rod.

On the end of the rod is a piece of corrosion-resistant spring steel over which is slipped a tubular cloth swab. Swab is dipped in cleaning solution and inserted into gage. When it is visible in the glass, you pull back the handle and tighten the thumb screw. This forces the spring to push the swab snugly against the glass. -Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass. 258A

Flaring Tool

Does job on copper tubing within ten seconds.

Copper and many grades of aluminum tubing can be flared perfectly within 10 sec. by the Spe-D-Flar tool.

To assure the perfect flare needed to hold pressure the tool is constructed so that the flaring pin always is aligned perfectly with the tabe to be flared. All working wearing parts are heat treated.

The five sizes available are t, &, t, and i in.-William L. Engesser & Co., 9745 East Rush St., El Monte, Calif. 258B

Fastening Tool

Enables plant craftsmen to drive fasteners manually into concrete or metal.

With the Shure-Set tool, a worker can drive a fastener through steel 1 in. thick. Also, it will seat fasteners in materials such as concrete, concrete block, cinder block and brick.

It is a well known fact that a needle can be driven through a coin if first it goes through a cork. Support of the pin by the cork makes this possible. The Shure-Set tool works on the same principle. Proper support of the pin means maximum utilization of the energy from the hammer.

Tool can be used by personnel installing electrical systems, instruments, plant protection systems, etc.—Olin Mathieson Chemical Corp., 460 Park Ave., New York 22, N. Y. 258C



Litter Car

Designed to speed accident cases to aid station.

For a seriously injured employee, this electric-powered ambulance can spell the difference between life and death. With three-wheel suspension and consequent sharp turning radius, it operates equally well within the plant or outside.

You can see there is room for driver, attendant or nurse and patient. Also, there is ample space for stretcher, oxygen equipment, medical bag, etc.

Six heavy duty batteries supply power for all-day operation. Built-in recharger quickly builds power back up to peak working capacity.—West Coast Machin-ery, Inc., 1801 East Charter Way, Stockton, Calif.



Resin-Cloth Patch Restores Tank to Service

Metal tanks, pipe and conduit can be patched without welding by using Sonite compound and glass cloth. Patches have great chemical stability, and good adhesion to metals, are oil and waterproof, resist acids and alkalis, and withstand temperatures to 200 F. Clean metal is primed and cloth patch pressed into position after prime becomes tacky. Then the filledepoxy Sonite compound is brushed over the patch. Additional layers can be added according to job requirements. Patches have been tested to over 1,000 psi. for extended periods. -Smooth-On Mfg. Co., Jersey City 4, N. J. 258D

Resistant Clothing

Combines comfort with toughness needed by heavy industry.

The new competitively priced line of Chem-Wear clothing is a light, tough garment that is far more comfortable than straight synthetic clothing and more durable than pure cotton or wool. The cloth in these garments is a blend of 68% Dynel with 32% cotton.

Addition of the cotton reduces the static which causes discomfort and reduced free-



The expansion plans of a chemical plant called for the design of a processing tank that was so huge it could not be shipped in one piece.

So the steel fabricator's engineers, working with "U. S." engineers, designed the tank in 2 parts. The tricky task of transporting these immense sections from the fabricator to the "U. S." plant (where U. S. Permobond protective linings were installed) and from there to the chemical plant was arranged by "U. S."

traffic specialists. When the 2 sections arrived at the chemical plant, "U. S." field service men vulcanized the joints after the halves were welded together, making a complete rubber lining with no seams or joints. Thanks to the Permobond® lining, the tank is immune to acid attack.

For protection against corrosion of tanks, piping, valves—get in touch with us at Rockefeller Center, New York 20, N. Y.



Mechanical Goods Division

United States Rubber

CHEMICAL ENGINEERING—September 1956

dom of action. Porosity, too, is greater.

Because of the high proportion of Dynel, Chem-Wear retains its shape, appearance and serviceability even after the cotton has been eaten away by chemicals.-Chem-Wear, P. O. Box 1044, Darien, Conn.

Industrial Glove

Made of an exclusive, nonabsorbing rubber pound.

Made of an exclusive, nonabsorbing butyl rubber compound, a new industrial glove protects the hands from the most destructive acids.

Glove is a one-fingered model with seam and crotch reinforced, is light green with a rough, stippled surface.

Under actual working conditions, tests have shown good resistance to sulfuric, nitric and phosphoric acids; oxygen; ozone; oils and salts.—Hood Rubber Co., Piv. of B. F. Goodrich, Watertown, Mass.



Fire Pump

Combined with foam unit on trailer can be moved manually.

Manpower alone is sufficient to move a recently developed trailer-mounted fire pump and foam unit combination. Or it can be hauled behind a vehicle easily and rapidly.

Trailer is designed to produce foam for fighting flammable liquid fires. Where water is available only from draft, the unit can produce high-pressure

streams of water instead of foam.

Trailer has storage capacity for 100 gal. of foam liquid, sufficient to produce 33,000 gal, of foam,-National Foam System, Inc., West Chester, Pa.



Steel Framing

Is labor-saving, do-it-yourself industrial building material.

With the Dexion slotted angle steel framing you can save labor, time and money on plant installations.

This all-purpose material is cold rolled steel angle with an electro-galvanized finish. Precision engineered slots and round holes, spaced at 8-in. intervals along the angle, enable rapid assembly and adaptability for building a wide variety of structures. A wrench and special cutter are the only tools needed.

Glidden Co. reported recently a 50% saving in labor cost by installing a catwalk of Dexion material to service seven paint vats. The structure was built in 20 hr.-Acme Steel Co., 2840 Archer Ave., Chicago 8, Ill. 260C

Conductive Shoe

Dissipates static charges as fast as they are generated.

Successfully tested under explosion-hazard conditions, a new static-conductive shoe dissipates static electricity as fast as it is generated. Modeled after manufacturer's line of slip-on shoes, it has vinyl soles that resist wear, are chemically resistant and maintain conductivity at a high level longer than any other conductive soling material.

Not only does shoe discharge all static electricity, but it remains flexible and retains its shape after long months of heavy use.—Bates Shoe Co., Webster, Mass. 260D

Graphite Dispenser

Speeds application graphite to friction surfaces.

A new graphite container and gun dispenses graphite with a squeeze of the fingers, Small enough to hold in the hand, the gun sprays dry lubricant at its target while held in any posi-

Enough graphite is contained in the unit for several thousand shots of lubrication. The area to be covered and the output of spray are determined by the distance the nozzle is held from the object and the pressure exerted.-Servwell Products Co., Cleveland 3, Ohio.

Electric Heater

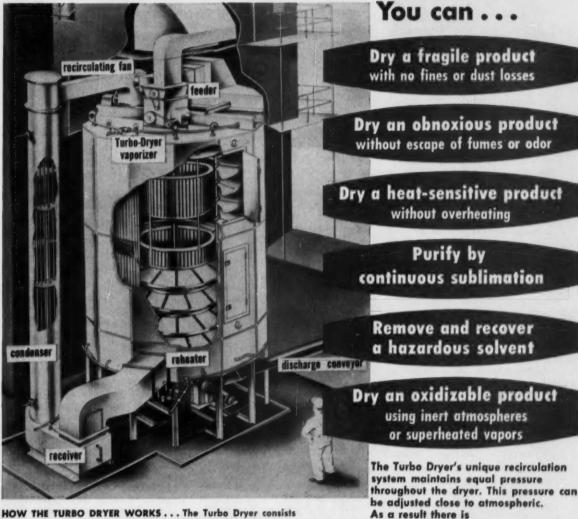
Has new hermetic seal to protect heating element from fumes or moisture.

A new ceramic-to-metal seal on tubular and tubular-finned electric resistance heaters prothe heating element tects against moisture and fumes.

Consisting of impervious alumina ceramic, the new seal has an expansion coefficient that matches the coefficient of the metal parts. Thus, the seal flexes with the metal as it heats and has high resistance to thermal shock. It will withstand cooling from 400 to 70 F. by immersion in water and from 800 to 70 F. by air.

Seal is recommended for temperatures up to 750 F. in air and 1,000 F. in inert atmospheres. Up to 4,000 psi. liquid pressure can be tolerated .-General Electric Co., Schenectady 5, N. Y.

WYSSMONT WWO DAYOU. Continuous, Closed Circuit System



HOW THE TURBO DRYER WORKS... The Turbo Dryer consists of a tray rotor, centrally located turbo fans and insulated housing. The product on each tray is wiped off after the tray completes one revolution through the recirculating drying atmosphere, falling on the tray below in a pile, which is leveled. From the lowest tray, the product drops onto the dryer bottom, whence it is swept into the discharge spout.

IMPORTANT INSTALLATIONS
NOW IN SUCCESSFUL OPERATION

- NEGLIGIBLE LOSS THROUGH LEAKAGE
- NO ELABORATE SEALING
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- **B** LOW INERT GAS MAKE-UP
- III HIGH SOLVENT RECOVERY
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Proportioning System

Includes control and recording for many feeders.

A recently completed Select-O-Weigh system includes automatic control and interlocking of a complex proportioning system that has 43 feeders. System also provides automatic recording of complete formula information.

Actual weights from the feeders are transmitted through the control panel to a printer which records complete information for each batch proportioned. The numerical code includes formula number; time, month and day of formulation; final cutoff point of each feeder; feeder identification number; total cumulative weighing of each scale; and grand total of all three scales.—Richardson Scale Co., Van Houten Ave., Clifton, N. J.

Psychrometer

Motor-driven portable unit meets Weather Bureau specifications.

Designed to rigid government specifications for use by the U. S. Weather Bureau, the Psychron psychrometer will be available to industry this fall. Compared to the widely used sling-type psychrometer, it is easier and safer to operate in close quarters, gives a more precise aspiration rate. It is not affected by solar radiation and has built-in illumination for the thermometer.

Thermometer bulbs are placed within a removable air intake leading to fan which moves air at 15 ft. per sec. Power comes from standard

1½-v. D batteries. Unit weighs 2½ lb., is 10 in. long, 4½ in. high and 1½ in. wide.—Friez Instrument Div., Bendix Aviation Corp., Taylor Ave., Towson, Baltimore 4, Md. 262B

Temperature Controller

Used with thermocouples employs photoelectric principle.

A new, inexpensive, automatic indicating and controlling pyrometer has been developed for use with chromelalumel, iron-constantan, and platinum-10% rhodium thermocouples. Operating on the photoelectric principle, controller eliminates moving parts and wear.

A beam of light, directed at the mirrored meter face, is interrupted by the pyrometer needle to actuate a simple control circuit.

Controller can maintain temperature within ½% limits. Also, it can be set as a limiting controller to shut off the heating device when temperature is reached.—The Jelrus Co., 136 West 52nd St., New York 19, N. Y. 262C

Mass Spectrometers

Modified to meet requirements for specific applications.

Versatility of the mass spectrometer is being widened these days by application engineering.

One modification revealed recently involves the addition of equipment to permit automatic multi-stream and multi-component analysis. Added to the Type 21-620 mass spectrometer are an automatic programmer, a peak selector, piping and valves for nine sample lines. Instrument is monitoring gases from oil wells to permit closer control of underground combustion of residual oil reserves.

Another modification of the same unit makes possible the analysis of liquid mixtures of gasolines and chemicals which have insufficient vapor pressure at room temperature. Inlet system is heated to 150 C. to vaporize the material so that it can be sampled at the normal instrument pressure range of 5 to 100 microns.—Consolidated Electrodynamics Corp., 300 North Sierra Madre Villa, Pasadena, Calif. 262D



Thickness Gage

Measures thickness of paint and other non-magnetic films.

With this new gage, you can measure non-destructively the thickness of non-magnetic films or coatings backed by magnetic materials. Measurements are made from the coated side of the coated object.

Operation of the instrument depends upon an internal alnico magnet which provides flux to the feet. The variable air gap in the magnetic circuit, introduced by the variable thickness of the film on the backing material, causes flux changes in the circuit. Variations in film thickness are measured in terms of changes in leakage flux by a gaussmeter-type movement used in a null-balanced manner.

Gage has two scales: 0 to 7 mils and 1 to 60 mils.—Gardner Laboratory, Inc., P. O. Box 5728, Bethesda, Md. 262E

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Mobile Crane

Can move any load shape to top limit of 10,000 lb.

The KE Karry Krane, designed to work within plant or in yard, can move readily any load shape that can be placed under its boom. For reaching into road trucks and box cars, there is choice of boom lengths, adjustable to six positions. For even greater versatility, optional hydraulic power topping is available to raise and lower the boom.

Powered by a more powerful engine than its predecessor, the Karry Krane lifts at 75 to 108 ft. per min. and lowers at 165 to 240 ft. per min.

Body and frame are extra sturdy because they are welded into one piece.—Hyster Co., 2902 Northeast Clackamas St., Portland 8, Ore. 264A

Automatic Scale

Built with special components for operation under hazardous conditions.

Designed for weighing cellulose acetate, polyethylene, other plastics and petroleum byproducts, the new model GGG-38 automatic scale meets Underwriters' Specifications for Class I, Group D conditions for hazardous gases or vapors.

Discharge mechanism of the scale is operated by air, rather than by the usual solenoid-activated device. Motor and electrical components are special, of course, for hazardous operation.

Scale is available in models weighing up to 250 lb. per draft. Normal speed range is up to seven 100 lb. weighings per min. Weighing accuracies of 0.25% or better are reported. —Richardson Scale Co., Van Houten Ave., Clifton, N. J.

264R

Batch Feeder

Particularly suited for handling dusty, corrosive or abrasive solids.

Pilot model of a new material feeder, the model 700N batching scale, recently has completed a one year test. It handled and discharged nickel oxide ore to reduction furnace in a large nickel-producing plant.

A unique rotary feeder charges a gateless, tipping-type weigh bucket. The weigh bucket is suspended from the scale. A cycle timer controls the automatic charging and discharging of the weight bucket.

No knife-edge pivots are used in the scale. Scale platform, levers and weigh beam are supported by the patented Thayer-Plate leverage system. With this feature, millions of weighings can be handled without any loss of accuracy or sensitivity.

Sizes are available for handling from 100 lb. to 100 tons per hr. with an average accuracy of 0.25%. Controls can be furnished for interlocking with existing material handling system or with other batching systems.—Thayer Scale & Engineering Corp., 494 East Water St., Rockland, Mass. 264C

Cable Elevator

With rubber-wheel drive that eliminates sprocket troubles.

Hi-Lift cable-veyor elevators have been designed to handle bulk materials rapidly on a lowcoat basis.

Elevator uses standard steel cable within the conveyor to reduce greatly the number of parts that can wear and cause trouble. Cable is assembled in standard sections with special flexible connections that avoid localized stresses. Low-cost buckets attached to the cable

are free to turn so wear is not concentrated on one edge.

Sprockets commonly used in elevators have been replaced by a rubber-tire drive. This drive operates quietly and is not affected by hard or abrasive lumps in the material conveyed. Also, a simple takeup screw can be adjusted to compensate for any gradual cable stretch.—Hapman Conveyors, Inc., Div. of Hapman-Dutton Co., Kalamazoo, Mich. 264D



Car Puller

Moves and spots freight cars and barges easier and cheaper.

An improved two-way double-drum car puller is producing substantial savings and improved efficiency on industrial railroad sidings. Merely by pressing pushbuttons, an operator can move as many as 12 or 14 loaded cars along a double-track siding.

Wire rope running along a double-track siding from one drum to the other is fitted with bull rings midway down each section. Attached to these bull rings are short lengths of cable ending in car hooks.

To move a car, or cars, a hook is simply slipped over a car sill or through the conventional car coupling. Then the puller is operated in either direction.

Because the double-drum design permits moving the cable in either direction, the heavy car hooks can be moved by the puller directly without having to be positioned manually.—Hewitt-Robins, Inc., Stamford, Conn. 264E

CONTROLLED - VOLUME PUMPING with

NO STUFFING BOX PROBLEMS!



The Pulsafeeder, in combining the good features of both piston and diaphragm pumps, provides an unusually dependable means of precision pumping. There is no stuffing box, hence the usual problems of maintenance and repacking associated with plunger-type metering pumps do not exist. The product being pumped is isolated from the pump's working parts by a hydraulically balanced diaphragm and is kept safe from contamination and leakage to atmosphere.



SUCTION STROKE

Positive displacement is achieved by a piston reciprocating within an accurately sized cylinder at an established stroke length, displacing an exact volume of hydraulic oil. By means of this oil, the piston moves the diaphragm alternately backward and forward. The displacement of this diaphragm travel takes in the liquid on the suction stroke of the piston and discharges a like amount of liquid on the discharge stroke of the piston.



DISCHARGE STROKE

WRITE FOR BULLETIN 440 with typical applications, flow charts, description and specifications of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 677 Wilson Street, Le Roy, N. Y.





Plastie Springs

Now can be made by mass production techniques making wide use possible.

In work sponsored by the Army Ordinance Corps, the National Bureau of Standards has developed a practical procedure for mass producing plastic springs. Because such techniques have not been available previously, plastic springs have not been utilized in chemical plants and similar installations where their corrosion resistance makes them valuable.

With the new technique, plastic springs are molded by drawing resin-soaked glass fibers through vinyl copolymer tubing. Then, the loaded tubing is wrapped into helical shape around a mandrel. After curing in an oven, the tubing is removed as a solid plastic spring which is reinforced with glass fibers.

Mechanical and thermal properties of the plastic springs can be varied widely by proper choice of materials and dimensions. — National Bureau of Standards, U. S. Dept. of Commerce, Washington 25, D. C.

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Postcard inside the back cover.

Bendable Tubing

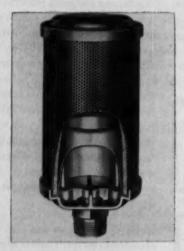
Can be made for conduit from wide choice of materials.

Plica tubing, originated in Switzerland, now is available in the U. S. Possessing unusual installation advantages, this tubing can be cut with a hacksaw or knife, bent to contours that hold without returning to the original orientation.

In Switzerland and other countries, Plica tubing has been used extensively as electrical conduit during the past ten years. It has a three-ply wall with high strength, watertightness and ability to be bent to sharp radii.

Almost any desired combination of ferrous and non-ferrous metals, fiber, paper and other materials can be used in the manufacture of tubing of this type.

Tubing is available in sizes from # to 2-in. I. D.—The Flex-aust Co., 100 Park Ave., New York 17, N. Y. 266B



Pneumatic Mufflers

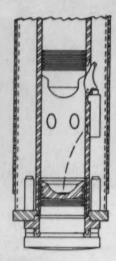
For air-operated equipment, improves muffling, installs easier.

Improved performance is reported for the new Atomuffler pneumatic muffler. Combination of a new four-way deflector and an internal acoustical resonator improves air dispersement and impingement. Air is dispersed outward in a lateral-

radial pattern which cuts velocity to a minimum and eliminates oil fog and water spray. Newly engineered disseminator permits passage of a greater air flow volume.

Double lock-tight construction resists vibration and holds fast under severe jolting. Atomuffler is available in sizes from ½ to 2 in. N. P. T.—Allied Witan Co., Inc. P. O. Box 2770, Dept. F-3, Cleveland, Ohio

266C

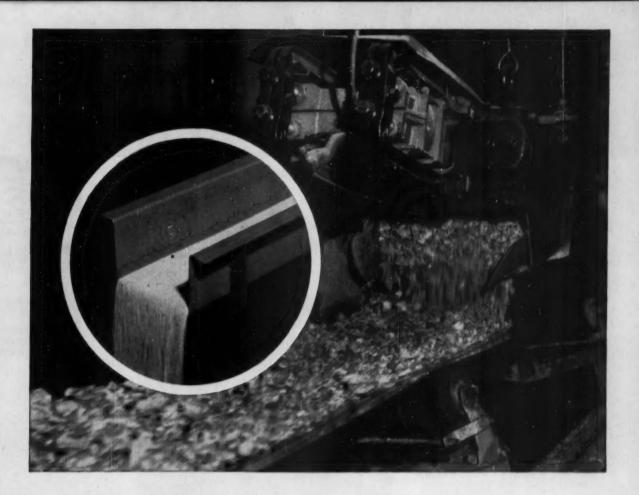


Pile Hammer

Is self-contained, operates with diesel, free-piston power.

Requiring neither boiler nor air compressor, a new diesel-powered pile hammer is completely self-contained, light mobile, versatile and compact. It can handle jobs that are considered uneconomical for conventional pile drivers, their associated auxiliary equipment and personnel.

During downstroke of hammer ram, it actuates a metering pump which squirts liquid fuel into pocket in the anvil block. When the ram strikes the block, it atomizes the fuel by impact. Heat in the air compressed around the nose of the ram ignites the fuel. Energy released by the ignition drives the ram upward and the anvil downward. Gases through ports uncovered during the upstroke of the ram .-McKiernan-Terry Corp., Dover,



Jeffrey puts VIBRATION to useful work

You can solve many problems of conveying solid materials with Jeffrey Electric Vibrating Feeders. Move fine powders or huge stone blocks . . . a few ounces or two thousand tons per hour . . . dripping wet or bone dry . . . at temperatures ranging from 30° below zero to 2,000° above. Materials are

propelled in a smooth, continuous stream by each forward vibration stroke.

Balanced vibration in the Jeffrey system matches electrical frequency to natural mechanical frequency of the driven equipment. This makes the system highly economical to operate, since all available energy does useful work. It is easy to control, safe, quiet and dependable. Vibration is scientifically isolated within the conveyor.

Jeffrey's years of experience with conveying problems enable us to furnish systems exactly right for each particular task. Catalog 870 describes the complete line of Jeffrey Vibrating Equipment. For a copy, and for help on your conveying problems, write The Jeffrey Manufacturing Co., Columbus 16, Ohio.



CONVEYING . PROCESSING . MINING EQUIPMENT . TRANSMISSION MACHINERY . CONTRACT MANUFACTURING

New Haridyne system...

Schematic of Coordinated Variable Speed System



Now you can obtain variable speed from AC squirrel cage motors

OUTPUT OF ALTERNATOR OUTPUT OF VARIDYNE MOTORS (example 4-pole motor) OUTPUT OF VARIDYNE MOTORS (example 4-pole motor)

in this conveyor of the Dolly Madison Plant of Interstate Bakeries Corporation, a baker's dozen drive motors are used -13 U. S. doublereduction gearmotors. All are controlled to matched speed from the power unit.

HOW Varidyne WORKS

The principle of Varidyne is based on the fact that AC motors operate at a speed proportional to the frequency of applied power. As shown in the chart above, a 4-pole induction motor which normally operates at 1800 rpm on 60 cycles will operate at 900 rpm at 30 cycles, or 3600 rpm at 120 cycles. Because power lines operate at fixed frequency, AC motors

operate at fixed speeds. The Varidyne system converts the fixed line frequency to a variable frequency by means of a Varidrive and alternator combination (power unit). This variable frequency is used to power one or more AC induction motors which then can be controlled simultaneously by regulating the power unit.

WHAT Davidyne CAN DO

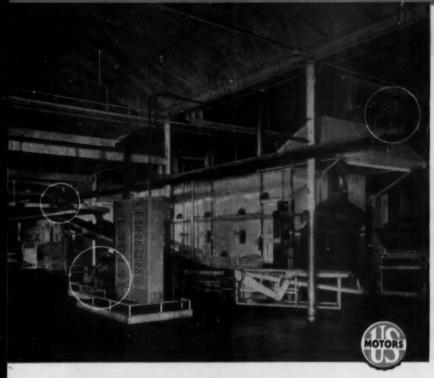
By the use of simple AC induction motors at the point of power application, Varidyne now provides the simplest and most dependable variable speed, multiple drive system obtainable. Motors of different speeds or types can be used in the same system and will change speed proportionately. Single motor systems can be supplied for applications with limitations of space, weight, temperature, vibration, etc. The rugged AC motors and circuitry of the system insure long trouble-free life, which reduces maintenance costs and eliminates special training for maintenance personnel.

EQUALIZED LOAD DISTRIBUTION automatically ACHIEVED

When the Varidyne motors are operating in tandem, as on a single conveyor, they will equally share the load. In earlier systems without equal load distribution, it was common practice to "overdesign" the conveyor with extra capacity motors, every chains and

aprochets in order to withstand higher loads at any one point of the conveyor. Damage from extreme overloads was prevented by shear pins which caused frequent breakdown and production interruptions. Varidyne motors diminate this castly, troublesoms practice.

a simple means for simultaneous speed variations

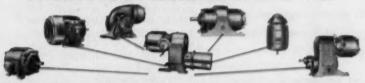


VARIABLE SPEED MULTIPLE DRIVES CAN NOW BE COORDINATED AND automatically CONTROLLED

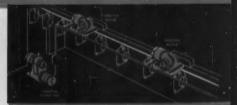
Varidyne may be furnished with Varitrol pneumatic control, which operates automatically in response to a signal from the process or operation. The trouble-free operation of many Varidyne systems already in use has caused

this new multiple drive system to be enthusiastically received throughout the nation. U. S. field engineers are prepared to give counsel and special service in applying Varidyne to meet your specific application.

VARIDYNE OFFERS WIDE SELECTION OF MOTOR TYPES



Selection of enclosure and speed range of Varidyne motors driven by the central Varidyne Power Unit is practically unlimited, including drip-proof, totallyenclosed and explosion-proof designs. Speeds of from 1 to 10,000 rpm are available in ratios of up to 5:1 and higher. Varidyne motors can be provided with integral gearing or with integral variable speed transmission for speed trimming. Varidyne motors can be furnished from ½ to 25 H.P. at maximum RPM. Power Units 1 to 50 H.P. connected load.



EARDIM MOUNTED DRIVES - The above example demonstrates two or more Varidyne motors driving a single conveyor. An important feature is the equal distribution of load between the Varidyne motors.



TWO MACHINES WITH PROPORTIONAL SPEEDS - Two or more machines or conveyors may be driven at same speed or at proportional speeds by a single Varidyne Power Unit.



sestial concernous—One or more Vari dyne induction motors meet special conditions such as restricted space weight limit dons, environmental hazards, etc., at the point of power application.



Varidyne motors with individual variable speed control can be used for trimming the speed within a system. The speed of the entire system can then be controlled simultaneously:

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P. O. Box 2058, Los Angeles 54, Celif., or Milford, Conn.

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U.S. Electrical

EDITED BY D. R. CANNON



CPI Automation: Much Already, More Soon?

No slouches with automatic process control, chemical engineers now must weigh pros and cons of moving closer to the ultimate-computer control.

William H. Chartener, McGraw-Hill Dept. of Economics

Engineers in chemical process industries have a right to scoff at "automation" as just a mouthfilling word for something they have been doing for years. Nevertheless, since the idea caught the public's fancy a few years ago its impact on process industries has been considerable, albeit not nearly as revolutionary

as in fields where automatic control is strictly a postwar innovation.

The chemical process industries converted to automatic materials handling and transfer, in most instances, before the war. In petroleum refining, for instance, batch processes were converted to continuous processes in

the 1920s-first by continuous flow from one shell still to another, then by adoption of pipe

Process industries also made big strides before the war in automatic control of various steps in process operations. Petroleum refiners were using onoff temperature controllers on dephlegmator towers before 1930. Flow, temperature, pressure and liquid level all were subject to controls by the mid-1930s.

▶ Big Business Now-With the great improvement in accuracy and speed of response that's come since those early years, far wider use has been made of automatic control devices. Sales of industrial process instruments, according to recently published Census figures, rose from \$168 million in 1947 to \$272 million in 1954. Instrumentation expenditures for liquid level control doubled in the same period-from \$19 million to \$40 million.

In the chemical and allied products industry a rising proportion of spending for new plants and equipment—as much as 20% for some companies-is going into automatic control instrumentation.

▶ Bigger Business to Come— Several, big steps in automation, however, still lie ahead for the chemical process industries. Some are close at hand.

· Data logging-Instead of measurements being read by an operator or chart-recorded for reading, they will be read automatically and simultaneously, corrected automatically to the desired form and printed out numerically on prepared log sheets by data logging equipment. Or the history of a process-maybe the last ten minutes, maybe the last ten hours-will be flashed on an oscilloscope screen for inspection.

Not only will data logging facilitate monitoring and analysis of production operations but it will also provide speedy and accurate information for account-

ing purposes.

• Continuous process stream analysis-Now in limited use for such purposes as pH measurement and control, automatic analyzers will find increasing use in

by C. H. WHEELER

Here you see two rolled Muntz Metal condenser plates, being drilled simultaneously in the plant of the C. H. Wheeler Manufacturing Co., Philadelphia 32, Pa. The plates were supplied by Revere. They measure 100-3/4" x 203-3/4" x 1-1/4" thick. Four plates were supplied for a Wheeler 2-pass divided water box unit having 95,000 sq. ft. of condensing surface. The overall length of the condenser, including water boxes, is 48 ft., and overall height, including steam dome and hot well is 34 ft.

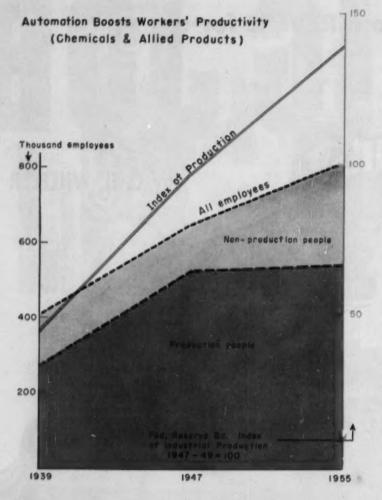
Revere is an important supplier of plates and tubes for condensers, heat exchangers, and similar equipment, shipping to all parts of the country. Collaboration on alloy selection and specification is freely available. Just get in touch with the nearest Revere Sales Office.



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controlling temperatures, pressures, flows and other primary variables. These instruments will reduce the delays of laboratory testing and the haphazardness of end product analysis.

· Computer control - Sometimes viewed as the ultimate in automation is computer control of an entire process. Now largely experimental, this would do away with manual adjustment of controls. Data picked up automatically would go directly into the computer to be compared with instructions previously given the computer. Any necessary corrections would be made automatically. Because of the computer's comprehensive view of the entire process sequence, it would be able to adjust operations at any any step to meet requirements further on.

▶ Technical Obstacles — These

new phases of automation, however, are still some years off for most companies. According to Joseph D. Yanak, instrument division engineer of the M. W. Kellogg Co., several major technical obstacles must first be overcome.

For one thing, knowledge of the dynamic characteristics of processes is limited. More precise information is needed before instruments can be used to close the control loop.

More accurate and precise primary elements will sometimes be needed before processes can be turned over to computers. In flow, an orifice plate will now give a satisfactory accuracy within 1½% to 2½%. In pressure measurement, ½% is usually good enough. But neither precision is good enough for computer control.

Electronic and mechanical dif-

ficulties are holding up data logging. Downtime has proved excessive on most installations. Further work must be done by instrument manufacturers to improve the useful life of these instruments, which must be operated 24 hr. a day, every day, to pay their way.

Economic Roadblocks, Too— High initial cost, during a period when rapid improvements in automation equipment are sure to come, is just as important an obstacle on the economic side. For improvements may make relatively new automation equipment obsolete overnight.

Heavy expense in equipment puts pressure on management to maintain continuous operation at all times wherever possible. Where labor costs are high, money can be saved during periods of slack demand by laying off workers. But it is not the same with expensive equipment whose cost must be promptly regained.

There is also the risk of inflexibility in automatic equipment if a change in product requirements (or of product) makes extensive adjustments necessary. Computer control, in particular, will contribute to greater flexibility, though. A major product change might be made just by putting in a new reel of tape.

Finally, many "old-fashioned controls"—pneumatic, hydraulic and electrical—still do an adequate job at usually a much lower cost and with more dependability than electronic gadgets of today's automation.

More, for Sure—The arrow points decidedly toward more automation for the CPI, these drawbacks notwithstanding—and towards increasing productivity. And why not, for consider what automation has done already. Look at the chart on this page and compare 1955 with 1947:

Production rose 43%, according to the Federal Reserve Board Index. But the number of production and related workers inched up only 4%.

Between 1939 and 1947, by way of contrast, a rise in production of about the same magnitude had required nearly a doubling of the number of production workers.



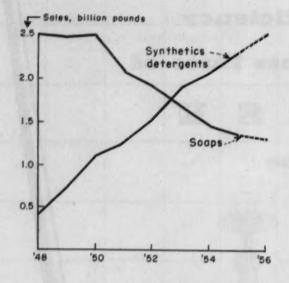
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- Synthetic detergents keep grinding and washing away at soap's stillshrinking markets.
- Even that venerable solid-seller, toilet soap, is menaced by upstart bar detergents.
- Yet producers managed to net more money on soap sales last year than they did in 1954.
- And more on syndets, which continue to yield better profits than the soaps they displace.

Shifts in Soaps and Syndets Perk Profits

Hugh T. Sharp, Assistant Editor

Paced by hustling new formulations, synthetic detergents are well on their way to another record-busting year. Look for total detergent sales to reach 2.5 billion lb. in 1956.

And even though soap sales are expected to slump to about 1.3 billion ib., the outlook is for a second profitable year in a row for most soap and detergent makers. (Earnings were a little lean for many in 1953-54.)

Actually sales records are old hat to synthetics—they've set a new one every year since 1946 when they first became a market factor. But the intense competition within the industry has often kept sales records from meaning comparable profits.

Recently, though, upgrading to higher priced soap products and the shift to synthetics are both helping firms widen their profit margins.

Figures First—To ferret this good sales-good profits story, first we'll look at the figures:

In 1955 the American Soap and Glycerine Producers Assn. reports sales of synthetic detergents, both solid and liquid, added up to 63.2% of the total market for cleansing agents. Some 2.317 billion lb. of synthetics were sold—up 12% over 1954's 2.063 billion lb. Dollar sales climbed to \$540.7 million, up 13.8% over the \$475.4 million reported in '54.

Soap sales, on the other hand, dropped 6.4%, to 1.35 billion lb., in '55, with a similar drop expected this year. But dollarwise, sales were \$320.1 million, 0.7% better than 1954.

▶ Behind the Figures—The fact that soap's dollar sales held their own despite a tonnage slip reflects an important shift in buying habits. A bigger percentage of the consumer's soap dollar now goes for the higher priced toilet soaps. Less is spent on the cheaper (per pound) powders, flakes and chips as the synthetics take over the jobs formally assigned to them. Why does the switch show a better overall profit per pound of cleanser (soap or synthetic) sold? The "substituting" synthetics offer a better return on the sales dollar.

Another promising example of lucrative product upgrading is the synthetic detergent in toilet bar form. Now in test markets, these bars are more effective than soap in hard water, they leave the bath tub "ring-free," they can be used by those allergic to soap.

But they're costly, harder to make and, right now, not too easy to sell to the housewife accustomed to the physical and cleansing properties of soap.

Selling at a premium price, bar synthetics have, nonetheless, shown enough marketability for some observers to expect them to take about a third of the toilet bar market by 1960. Others predict they'll eventually hold 65-75% of that market.

▶ Watch the Liquids—Liquid detergents accounted for nearly 7% of last year's total for synthetics. This year they'll probably grab more than 10%. In 1955, 153 million lb. were sold, nearly 30% more than in 1954. This year's first quarter reports reveal the sale of 64 million lb., a startling 95.3% rise over the same period in 1954 and a 38.9% increase over previous quarter.

The sales boom for liquid synthetic detergents should continue, especially in view of this year's introduction of heavy-duty products. These, too, are now in test markets, but nobody expects them to tarry there long.

They pick up where light-duty products—designed for hand dishwashing—leave off, and fit right into the washing machine

turns the wheels...

To the Escambia Bay Chemical organization have come men possessing many years of experience in the chemical and plastics industries.

These men with their experience and know-how are backed by Escambia Bay's emphasis on continuing research, development, quality control, and product uniformity.

And with Escambia Bay coming on stream this fall with its Polyvinyl Chloride Resins Plant, this know-how will make its contribution to the continued progress of the plastics industry through intensive technical and customer service programs.

The first product—a general purpose, easy processing Polyvinyl Chloride Resin—will be in production soon for use in the calendering, extrusion and molding industries. Following this, Escambia Bay will produce a molecular weight range of straight PVC Resins including types for electrical and rigid applications.



The mileties

ESCAMBIA BAY CHEMICAL

CORPORATION

261 MADISON AVENUE . NEW YORK 16, N.Y.

picture, And they're being touted as all-purpose cleaners—good for anything from nylons to stoves.

Based on mercury cell potassium hydroxide (for greater solubility), these heavy-duty liquids will find a big market in home dish- and clothes-washing machines which will be equipped with built-in chambers for the liquids and metering devices for feeding the correct amount to the wash water. Advent of such machines will assure a steady and growing market for heavy-duty liquid detergents.

No Slump for Nonionics—While it will take new designs to boost the use of liquids in automatic washing machines, low sudsing, nonionic type solid synthetic detergents are growing with the sales of conventional automatic washers. Nonionics now hold nearly 20% of the total

synthetic market.

Though higher priced, they offer a number of advantages over the heavy-selling anionic types. They don't clog a washing machine with suds and they're more stable. Since they're compatible with cationic surface active agents, they can be used to make nonionic-cationic mixtures which preserve the germicidal action of the cationics and are effective sanitizers.

Price is the major drawback of the nonionics. But new nonionic synthetic detergents have been prepared—from sugar (Chem. Eng., Jan. 1956, p. 142) and tallow.

Based on sugar (8¢/lb.) and tallow (7¢/lb.) rather than ethylene oxide (15¢/lb.), they promise lower costs. And these new nonionics are nontoxic, nonirritating, odorless, tasteless and, of course, low sudsing.

Look for them to play a big role in specialty products (shampoos, tooth pastes, etc.) and to offer a real challenge to the

anionics.

▶ One Dark Cloud—New products on the way, a growing population to serve, constantly improving living standards for that population, long and successful experience in selling its wares—little wonder the outlook for the detergent industry is bright.

There is one dark cloud on the horizon, though. Procter &

Chemical Consumption



Consumption by Industries

	April	May
	(Final)	(Est.)
Coal products	12.5	13.0
Explosives	10.9	12.0
Fertilizer	80.5	74.0
Glass	26.4	27.3
Iron & steel	19.3	19.2
Leather	4.2	4.1
Paint & varnish	32.8	35.3
Petroleum refining	29.2	29.2
Plastics	24.9	25.5
Pulp & paper	34.4	39.2
Rayon	28.4	27.6
Rubber	6.8	6.9
Textiles	9.7	10.9
Total	320	324

Gamble's board chairman, Richard R. Deupree, points it out: "We didn't think the soap industry could become more competitive, but it's becoming so because of new competitors from the chemical industry."

Who Wants What from the CPI?

The DuPont company, never one to sit on its haunches and watch the world go by, recently asked companies in varied fields what products they wanted from chemical processing industries. Some provocative answers, published in the DuPont Magazine:

Steel-Industry wants chemicals for upgrading and concen-

tration of low-grade iron ores; a simple process for rendering non-magnetic materials separable by magnetic means; a way to recover manganese from low-grade ores and industrial slag; and a two-way lining to prevent rust and replace tin as a coating for food containers.

Construction—Industry wants adhesive bonds, plastic cores and porcelain finishes that last as long as brick, mortar and stone.

Food—Industry wants better ways to process and handle meats; better chemicals to control spoilage (e.g. a preservative applicable to food by dipping), prevent discoloration, loss or change of flavor; and synthetic flavors that are not merely better initations of natural ones but which are unlike any we have now.

Autos—Industry wants high octane gasoline at prices which will permit further boosts in compression ratios; and "an economy grade diesel fuel of uni-

form quality."

Textiles—Industry wants products for bonding fibers into fabrics with all the properties of woven cloth; a method of improving wool grease recovered from the neutral scouring process; a satisfactory piece-dyeing process for wool; and a more durable water repellent for woolen fabrics.

Jet engines — Industry wants fuels stable at supersonic speed-generated temperatures; and synthetic lubricants operable in a jet at temperatures of -65 to

450 F.

Producers Shift to Bread And Butter Chemicals

In the chemical industry basic chemicals—the "heavy" stuff that's sold to companies for processing to consumer products—are recognized as small profit-returners, albeit steady earners.

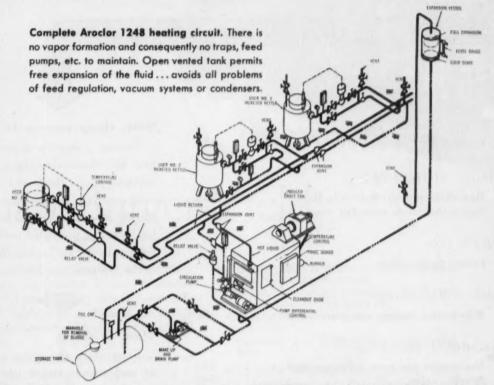
A lot of basic producers have in recent years been increasingly enamored of more profitable upgraded products, as evidenced by vigorous postwar diversification programs. Pinched by price controls and excess profits taxes, these firms found it difficult to justify high capital outlays for basic chemical facilities on the basis of only modest returns on

Now . . . NON-PRESSURIZED liquid-phase heat systems that operate up to 600°F.

AROCLOR 1248

Operates at atmospheric pressure...cuts installation and maintenance costs of expensive pressurized systems.

Fluid is fire-resistant...increases safety by eliminating direct-firing, or heat transfer with flammable fluids.



The Equipment...capacities can range from small portable units—usually electrically heated—to large gas- or oil-fired units generating from 250,000 to over 10,000,000 B.T.U.'s per hour. Circuits are closed, forced-circulation. Compact design saves space, minimizes installation and maintenance costs.

The Fluid... Aroclor 1248 is a highly stable chlorinated polyphenyl; does not support combustion up to its boiling range 652° to 725° F.; has autogenous ignition temperature of extremely high 1299° F.; is non-corrosive. Aroclor 1248 operates in most systems four to seven years without replacement.



Contact Monsanto for SOURCES of AROCLOR 1248 heating systems

Write to us on your company letterhead. We will send you technical information about Aroclor 1248 and/or the names of Aroclor 1248 heat-transfer system manufacturers and designers. Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. IF-2, St. Louis 1, Missouri.

AROCLOR: Reg. U. S. Pet. Off.

basis of only modest returns.

Dwight Moody, writing in the Journal of Commerce, detects, in company announcements of planned expenditures, an inclination of late on the part of these same basic producers to view their bread and butter business with a more appreciative eye.

One reason for the shift is, of

PICTURED FLOWSHEET

course, that the market potential of heavy chemicals is if anything enhanced by the surge of the entire chemical industry since the war. Another encouraging factor is today's political climate which is more sympathetic to business.

But Moody points to the intense scramble of both nonchemical and chemical companies to get into lucrative chemical upgrading ventures as a less obvious and perhaps most compelling reason. He suggests that the heated competition in these fields may be narrowing profit margins to the point where manufacture of basic materials becomes attractive once again.

GUIDED TOUR CONTINUED



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Protective linings for process equipment Nov.
Cavitating venturi to control flow
Nuclear who's who

More, cheap tonnage O2, N2

Tonnage production of the onetime fine chemicals oxygen and nitrogen places these important raw materials on the chemical market at a low price. Here's how the top processes perform the feat for the six leading outfits in the business. (p. 354)



Talent on parade

Biographies and backgrounds of your authors add weight and importance to their contributions in this issue. (p. 384)



Technical Literature

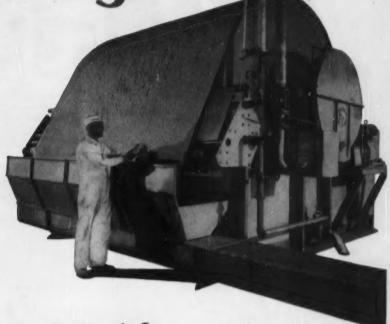
You can get—free and fast—literature on any subject in your field. Keep files up to date the easy way. (p. 454)



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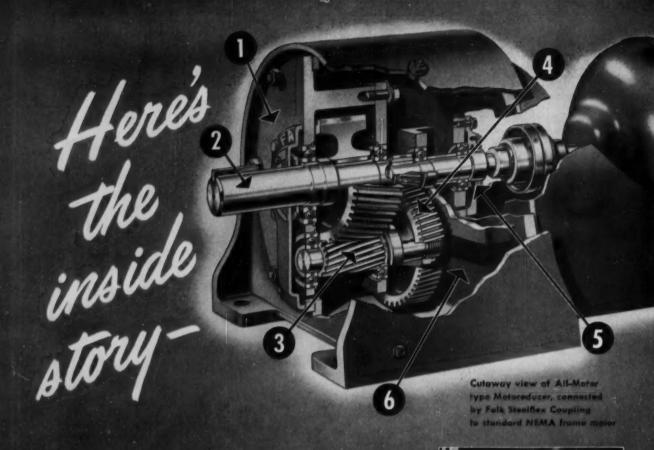
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WHY Falk Motoreducers give better service-have longer life

Here is the "inside story" behind the all-steel All-Motor type FALK Motoreducer's universal reputation as a gear drive unmatched in quality, efficiency, dependability, ease of maintenance and long life. These "In-built" factors are-

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- A EXTRA-CAPACITY GEARING. Special extra-capacity gear-tooth form with larger contact area gives greater strength, higher load-carrying capacity.
- SEALED HOUSINGS. Splashproof, dustproof, oil-tight construction. Dual closures and one-way vents keep oil in, dust and moisture out.
- POSITIVE LUBRICATION. Large sump capacity...oiltight construction assures clean lubricant...revolving elements lubricated by direct dip.

When you buy or specify the All-Motor type FALK Motoreducer, you get all theseplus the tremendous advantage of full interchangeability of motors. Switch motors as desired—use any make, style or type of standard foot-mounted motor within the unit's AGMA rating—with a minimum of difficulty or "down time."

Available in sizes up to 75 hp-with or without motor-from convenient factory, field or distributor stocks, from coast to coast. Write for Bulletin 3100.



60,000 HOURS WITHOUT A FAILURE!

Sixty thousand hours is a lot of hours-but the FALK Motoreducer in the unretouched photo above has served that long without failure or need of repair.

This 3 hp unit is one of over 60 FALK Motoreducers in daily service in an Eastern plant of a large milling company, whose president says, in part:

"One of the main advantages of FALK Motoreducers is their adaptability to any motor. Reducers and motors can be easily Interchanged.... Our service records confirm the wisdom of our choice of FALK equipment as our standard."

THE FALK CORPORATION, MILWAUKEE, WISCONSIN MANUFACTURERS OF

- Speed Reducers
 Flexible Couplings

- High Speed Drives
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 Single Helical Gears
 - Steel Castings
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...a good name in industry



VENSON EVAPORATORS

help produce better sugar...



at lower costs



Refiners of beet sugar are experiencing new success through an improved method of processing-Swenson Multiple-Effect Evaporation. Swenson high-velocity LTV pressure evaporators are generating essentially all of the process vapors used in modern beet sugar factories. Heat economies of approximately 500,000 BTU per bag of sugar are being obtained. Food, chemical, pharmaceuticalalmost every type processing industry -has profited substantially from Swenson Evaporation equipment. The reason: Swenson Evaporators can improve product quality while lowering production costs. Your product could be next. The surest way to find out is to talk with a Swenson engineer. Call or write today.

SWENSON EVAPORATOR CO.

15669 Lathrop Avenue, Harvey, Illinois

Phoved Engineering for the Process Industries



CHEMICAL ENGINEERING—September 1956







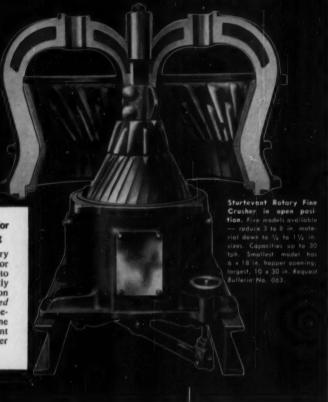


PRODUCTION ALWAYS ON SCHEDULE

"OPEN-DOOR" DESIGN

"One Man, One Minute" Accessibility for Inspection, Clean-outs, Trouble-shooting

One man can swing open a Sturtevant Rotary Fine Crusher in a matter of minutes — for inspection and maintenance — thanks to Sturtevant's unique "Open-Door" design. Costly downtime is cut to a minimum, production kept on schedule — even when the inexpected happens. Little wonder that users say: "Because of their rugged construction and "One Man, One Minute" accessibility, Sturtevant machines give us lower operating costs over more years."



STURTEVANT ROTARY FINE CRUSHERS REDUCE SOFT TO SEMI-HARD MATERIALS FASTER, MORE ECONOMICALLY

For uniform crushing of soft (clay, charcoal) to moderately hard materials (softer limestone, cement clinkers), the Sturtevant Rotary Fine Crusher is practically nonclogging — much faster than other machines, less costly to operate.

Smooth production flow. The single turning of a hand wheel regulates the output size (from 1/4 to 11/4 in. on largest model) — provides a uniform product, dustless operation, steady output for greatest production efficiency.

A lifetime of low-downtime service. Built into Sturtevant Rotary Fine Crushers is Sturtevant's 83 years of successful engineering of dry processing units and equipment. Rugged construction, plus easy accessibility provided by Sturtevant's unique "Open-Door" design, assures more output per machine year.

Write today, Address: Sturtevant Mill Company, 100, Clayton St., Boston 22, Mass.

STURTEVANT Dry Processing Equipment

The "OPEN-DOOR" to lower operating costs over more years

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS



JAW CRUSHERS

Reduce corre (5 in, lergest medel) to fine (½ in, smallest medel). Eight medels renge from 2 x 6 in, jow opening (tob medel) to 12 x 26 in. Capacities to 30 tph. All except two smaller sizes operate on double com principle—crush twice per energy unit. Request Bulletin No. 062.



RING ROLL MILLS

Reduce hard or soft 1/2 in. and smaller material to from the 200 mesh. Grind only—ne screens. Capacities of a models range up to 18 thy depending on model and material. Ring diameters and faces 24 x 7 in., 45 x 8 in., 44 x 14 in. Request Bulletin No. 079.

ALL STURTEVANT MACHINES ARE DESIGNED TO OPERATE ADVANTAGEOUSLY IN "UNITS"



HAMMER MILLS

Reduce to 20 mesh. Swing-Sledge Mills crush mederately heard meterial up to 70 tph. Hinged-Hammer Pulverliers crush softer material of rates up to 30 tph. Feur Swing-Sledge Mills with feed openings from 6 x 5 in. to 20 x 30 V₂ in. Feur Hinged-Hammer Pulverliers from 12 x 12 in. to 12 V₂ x 24 in. Request Sulfetin No. 084.



CRUSHING ROLLS

Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mash with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in., rates to 87 tph. Three types — Balanced Rolls for automatic adjustment in operation; Plain Balanced Rolls; Laboratory Rolls. Recomended for 3 to 1 reduction. Request Bulletin No. 065,

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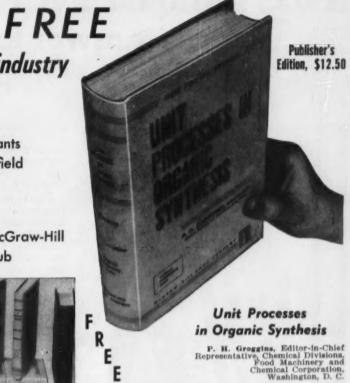
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Is USS NATIONAL' PVC PLASTIC PIPE

the answer to your corrosion problems?

The chemical industry has solved a wide variety of plant corrosion problems through the use of polyvinyl chloride plastic pipe, This pipe—specifically designed to do a *better* job than any other material for certain tasks—possesses not only excellent chemical resistance but remarkable physical properties.

Two types of extruded National Polyvinyl Chloride Plastic Pipe are available. Sizes run from ½" to 6" dia. inclusive, in Schedules 40 and 80. NORMAL-IMPACT is designed for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance. HIGH-IMPACT is designed for installations requiring excellent chemical resistance and a high degree of toughness, even at low temperatures.

The following properties are found in both Normal- and High-Impact National PVC Plastic Pipe:

Chemical Resistance—resists attack by acids, alkalies, salt solutions, and alcohols, as well as many other types of chemicals. Nontoxic. Will not impart taste or odor to liquids.

Rigidity — permits use in overhead piping installations with pipe supports. Schedule 80 pipe may be threaded with steel threading dies.

Lightweight — twenty feet of 2-inch Schedule 40 pipe weighs less than 13 pounds. Easy to install in cramped space and hard-to-reach places.

Weather Resistance—resists deterioration due to aging when exposed to direct sunlight. Also resists fungi, bacterial action and soils.

Ease of Installation—fittings readily attached by either solvent cementing, threading, heat welding, or adhesives.

Smooth Internal Surface—results in low flow resistance, minimizes the build-up of deposits.

For further details on USS National Polyvinyl Chloride Plastic Pipe, including a complete list of chemical resistances, send for Bulletin 24. Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

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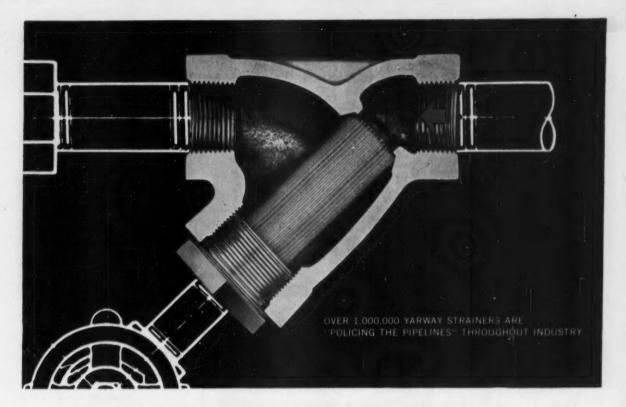
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it's GOOD ENGINEERING to install YARWAY STRAINERS

It's good pipeline engineering to install strainers that are well-engineered—Yarways.

Yarway Fine Screen Strainers protect equipment, prevent dirt, scale, chips, welding dross, etc. from reaching working parts.

Yarway Strainers feature Dutch weave Monel woven wire screens with high mechanical strength

and extra fine straining service. Perforated screens in Monel, stainless steel or brass are also available for certain services.

Screen is easily removed for cleaning. Unscrew screen cap and screen comes out with it. When replacing screen, straight threads assure correct alignment, no distortion of screen.

Yarway Strainers are made in iron or steel with rust-resistant finish—also in bronze, stainless steel or aluminum. 10 standard sizes from ½" to 3". Lärger sizes to order. Nearly 300 Industrial Distributors stock and sell Yarway Strainers. For the name of the one nearest you, and Yarway Strainer Bulletin S-204. write





FINE SCREEN STRAINERS

ACCELERATION COLLISION IMPACT IMPLOSION

in a Gaulin Homogenizer makes many products better – more economically

A Gaulin Homogenizer does three very important things to a product—it shears, expands and explodes, agglomerates down to their ultimate particle size.

The results of this particle acceleration go far beyond just making products uniformly finer, faster, more economically. In most cases, the physical characteristics of a product are modified.

For example, here are some typical property changes. A Gaulin will stop separation. Accent taste, scent, and color. Improve texture, flow lubricity. Speed chemical reactions, and dispersion of ingredients. And reduce the amount of expensive materials needed.

How about your product?

We'll be glad to show you just how a Gaulin can improve your product — and work with you toward solving any specific problems you may have. Write today for more information.

MANTON-GAULIN MFG. CO., INC., 71 Garden Street, Everett 49, Mass.

Some Typical Products Improved by Gaulin Homogenizers

PHARMACEUTICAL

Emulsions and dispersions. Gaulins make them stable, uniformly finer. Permit accurate reproduceability.

LIQUID STARCH

Improves transparency, clarity, and stops separation, at lower cost than other methods.

GREASE

Improves lubricating value and stability. Increases service life.

PIGMENT DISPERSIONS

Provides continuous high capacity producing dispersions of ultimate particle size.

COSMETIC EMULSION

Gives smoother texture, longer shelflife. Locks in perfume against evaporation.

WAXES

Makes accurate reproduceability possible. Provides uniform, stable emulsions and convenient viscosity control. Increases gloss.



GAUIN 1WO-3 lack cocton mixe Stator is jacketed for cooling or heating. Gap setting adjustable for .001° to .045° Only 45 second clean-up required in changing colors. 12° head room. 12° x 17° floor area.



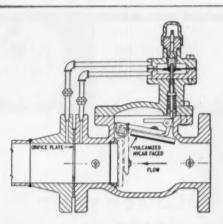
HOMOGENIZERS

WORLD'S LARGEST MANUFACTURER OF HOMOGENIZERS, TRIPLEX STAINLESS-STEEL HIGH PRESSURE PUMPS, AND COLLOID MILLS

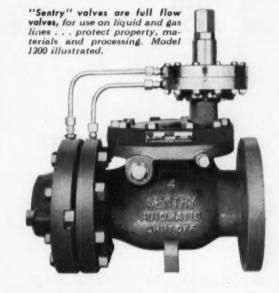
GAULIN PILOT PLANT HOMOGENIZER

Ideal for experimental purposes, operation or process requiring up to 25 gallons per bour capacity. Handles quantities as small as one pint. Available on low rental basis.

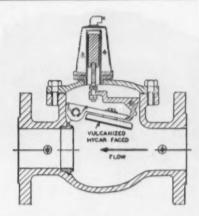




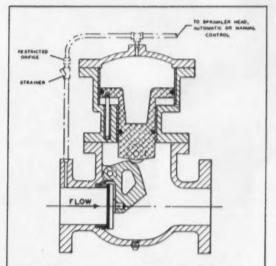
Model 1200. "Sentry" excess flow valve automatically and instantaneously shuts off when the rate of flow in the line exceeds a predetermined rate.



Other types "Sentry" Valves: high-pressure and lowpressure and over temperature shut-off valves available.



Models 1700 and 1800 "Sentry" solenoid shot-off valves operate by remote electrical control automatically and instantaneously. In Model 1700, solenoid is energized, in Model 1800 solenoid is deenergized to maintain flow.



Model 3000 "Sentry" piston operated quickopening valve opens instantaneously when the pressure above piston is released. Ideal for deluge systems — and for remote opening and closing of fuel line.

Now Coppus brings you "Sentry" Valves for automatic protection

These valves are patented quickclosing latch type and quick-opening piston type. All are full flow valves.

Latch-type "Sentry" valves are widely used in the chemical, petroleum and gas industries for closing automatically and instantaneously gas, process and fuel lines. The piston type valve can be automatically or manually opened and closed

from any remote location. It is ideal for deluge systems, operates instantly; closing of this valve is against the flow, eliminating water hammer.

Sizes run from 1½" to a full 8". For full information send for Coppus Bulletin 500 to Coppus Engineering Corporation, 229 Park Avenue, Worcester 2, Massachusetts.

COPPUS
"BLUE RIBBON" PRODUCT

LOOK FOR THE BLUE BAND THAT IDENTIFIES COPPUS QUALITY

Respiratory Protection



Lower your Costs... Simplify Stocks with AO R-2000 Series

8

Respirators

1

Accept No Substitutes

Here's top flexibility and cost savings, too, in respiratory protection for the plant with two or more hazards!

FOUR chemical cartridges, THREE re-usable dust filters, and ONE chemically treated throwaway dust filter can all be used in one basic respirator (and quickly interchanged as needed) for protection against a multitude of hazards.

- 1. R-2000 with throwaway all-dust* filter
- R-2015 with re-usable pneumoconiosis-producing and nuisance dust filter
- 3. R-2016 with re-usable toxic dust* filter
- 4. R-2017 re-usable all-dust* filter
- 5. R-2031 with organic vapor chemical cartridge
- 6. R-2032 with acid gases chemical cartridge
- R-2033 with combined organic vapor and acid gases chemical cartridge
- 8. R-2034 with ammonia and alkali vapor cartridge

R-2031 Respirator may also be used for paint spraying with arganic vapor cartridge and auxiliary filter. Your nearest AO Safety Products Representative can apply seems.

^adusts not significantly more taxic than lead



†T.M. Reg. by American Optical Company

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Ideas Unlimited!



URETHANES based on NACCONATES*



National is going all-out to help users develop volume applications of the exciting new urethanes. We offer:

Assured Large-Scale Supply of a complete line of disocyanates from our new multi-million dollar Mounds-ville, W. Va. NACCONATES (disocyanates) plant. With this major plant coming on stream soon, urethane makers and users can confidently schedule volume production.

Comprehensive Product Data in a series of six National Technical Bulletins, the most complete "product-data package" available. Ask for Bulletins I-17 to I-17E.

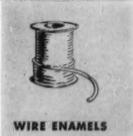
Application Data on principal urethane uses are being developed for National NACCONATES users. Our major application research program now under way at our Buffalo Research and Engineering Center is developing practical starting formulas, test data and use results on such uses as flexible and rigid foams, coatings, adhesives, plastics, etc.

On-the-job Technical Service on production problems, assistance on polyester resin procurement and equipment-supplier contacts.

We invite you to use our across-the-boards help to broaden your uses of urethanes.

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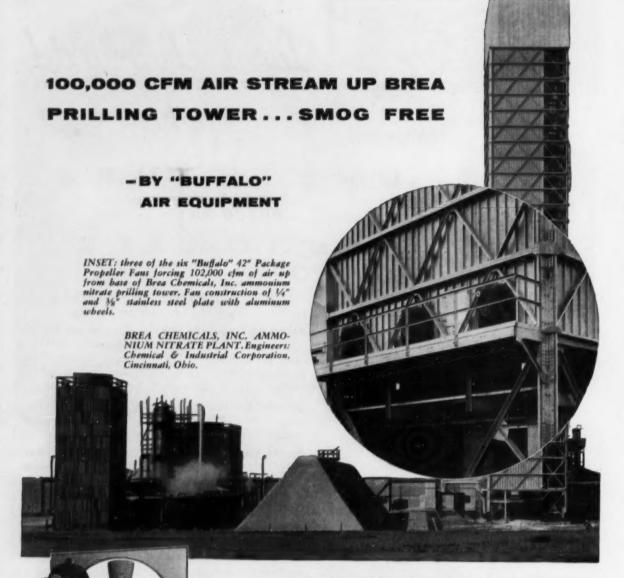


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E-2



"Buffalo" Design 53 Package Propeller Fans are ruggedly built of ¼" steel plate with die-formed orifices, for beavy industrial service. First, an elevator ride, then a bath is what happens to air in this prilling tower at the Brea, California ammonium nitrate plant of Brea Chemicals, Inc., subsidiary of Union Oil Company of California. Nine husky "Buffalo" Package Propeller Fans move the air upward against the falling ammonium nitrate solution to form the prills—six 42" fans forcing the air up from the tower base and three 54" fans inducing the draft from the top. Then, before leaving the tower, the air is cleaned of nitrate dust by a special "Buffalo" Air Scrubber of aluminum construction with all stainless steel piping and nonclogging "Buffalo" Spray Nozzles installed at top of the 200' Tower. Here is one more case where the chemical industry relies on "Buffalo" for its important air jobs. For the vital "Q" Factor of built-in Quality that means satisfaction and long life, have your contractor or engineer write "Buffalo" into the specifications for your next air job. You will be buying performance backed by a 79-year record of air leadership.

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING





Any way you look at it you get more mixer value per dollar from phillie gear



Ever see a mixer this big? Built for agitation of very viscous material in a vertical tank, the sear reducer alone weight 9000 pounds. Driven by a 75 MP metor the 154 MP capacity of the sear unit provides a generous service factor for unusual operating conditions. The 7" diameter that is more than 16 feet long. When you're thinking of big mixers for any process—think of Phillie Gear.

While the illustration above shows a larger agitator than you may ever require . . . for any fluid mixing job, any process condition, or any kind of mixing, doesn't it stand to reason that a heavier, more powerful, better designed mixer will do more work for you, dollar for dollar, at less cost?

Here's how, size for size, unit for unit, Philadelphia Mixers give you more mixer value per dollar invested.

(1) Philadelphia offers more horsepower capacity per dollar: All reducer drives are designed and built with generous service factors for long, quiet, trouble-free operation.

(2) All component parts are designed for extra heavy duty and provided at no extra cost: Extra heavy-duty output shafting, 75,000 hour service tested thrust bearings, heavy-duty inboard bearing supports, spiral-bevel gears of hardened steel and over-sized anti-friction bearings for rigid shaft support are all designed specifically to provide highest level of efficiency and economy. Dollar for dollar, you get more with Philadelphia Mixers.

(3) Philadelphia Mixers are easier to install and less expensive to service: Exclusive low headroom design permits maximum bearing span with minimum headroom. For closed tank agitation, the new Philadelphia-Garlock unitary mechanical seal assures long, maintenance-free service and, when neces-

sary, is replaceable in minutes with no special lifting equipment needed.

Here's why Philadelphia Mixers can give you more mixer value per dollar!

No other manufacturer controls, within its own organization, such extensive and specialized designing, engineering, manufacturing, assembling, quality control and field servicing facilities devoted exclusively to fluid agitation production and operation. Phillie Gear manufactures all gears, couplings and reducer housings and machines all shafts, drive supports and impellers. As a result of such completely integrated "packaged" service, you can be sure that every Philadelphia Fluid Mixer will perform smoothly, efficiently, quietly and economically beyond the maximum specified limits for any given installation.

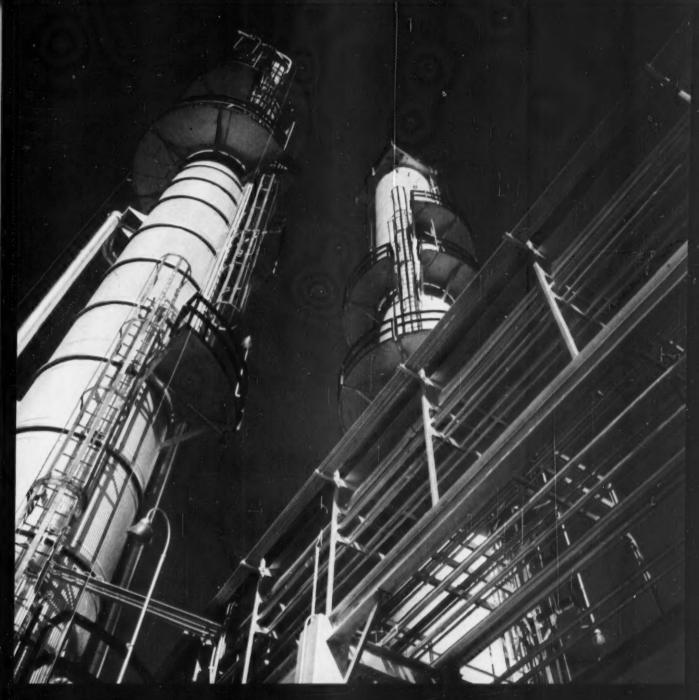
For the complete story on our standard line of mixers or special units for big jobs, send for Bulletin A-156.

philadelphia mixers.

PHILADELPHIA GEAR WORKS, INC. ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

INDUSTRIAL GEARS & SPEED REDUCERS LIMITORQUE VALVE CONTROLS FLUID AGITATORS • FLEXIBLE COUPLINGS

Offices in all Principal Cities Virginia Gear & Machine Corp. . Lynchburg, Va.



Alcoa Products for the Chemical and Petroleum Industries

ALUMINUM for

Process Equipment • Transfer and Storage • Plant Structures

CHEMICALS:

ALUMINAS for Catalysts • Bed Supports • Desiccants • Refractories GALLIUM--FLUORIDES

Aluminum in Process Equipment

Aluminum is widely used in many types of processing equipment because of its unique combination of desirable properties:

Excellent resistance to corrosion

Light weight

Good workability

Low cost

High thermal and electrical conductivity

Great strength in alloys

Nonmagnetic and nonsparking characteristics

Nontoxicity

Good reflectivity

Clean, attractive appearance

No other metal combines all these properties, so no other metal can be used with comparable results in so many different process applications. And even in those applications where other metals could be substituted, the cost of Alcoa aluminum often is substantially less.

In the processing of foods and beverages, the refining of petroleum, the production of basic chemicals and pharmaceuticals, the manufacture of paper and plastics, and in many other processes, aluminum is doing hundreds of jobs and doing them well.

Some of the principal applications of aluminum in the process industries are de-



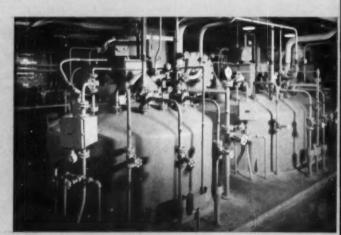
scribed briefly here. More detailed information on the behavior of aluminum with specific materials, as well as design and performance data are contained in the book, *Process Industries Applications of Alcoa Aluminum*. Your copy will be sent promptly on request.

Process Vessels

Aluminum can be readily fabricated by conventional methods into heat exchangers, kettles, storage tanks, stills, driers, pasteurizers, towers and other process vessels. Because it resists attack by many materials often regarded as corrosive, aluminum can be used in a wide variety of operations. Excellent heat conductivity makes it especially useful in vessels where heat must be applied to the product. Because aluminum can be kept clean and looks clean, it is particularly appropriate for use in food processing plants.

appropriate for use in food processing plants.

Aluminum vessels impart no undesirable color or flavor to the products. They can be used for fermentation reactions in brewing and in microbiological production because aluminum is nontoxic to the micro-organisms.



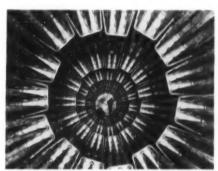
3,000-gallon aluminum adsorption tanks are used in the production of Chloromycetin and streptomycin.

Heat Exchanger Tubes

The qualities which make aluminum well suited for use in heat exchanger tubes are low cost, resistance to oxidation and other chemical attack, ease in fabrication, and excellent thermal conductivity.

Corrosion problems often are accentuated at elevated temperatures. Aluminum tubes have demonstrated their ability to give long, dependable service under severe conditions. They are used extensively in exchangers for handling hydrogen peroxide, nitric acid, hydrogen sulfide, ammonia, soda ash, naval stores, glycerine, acrylonitrile and other chemicals. Alclad tubes are particularly used to resist premature perforation from natural cooling waters.

Aluminum costs less initially than other materials—½ less than admiralty, less than ½ the cost of stainless, and in the common ¾" and 1" sizes, less than mild steel.



Interior view of the world's largest rotary steam tube dryer, made of aluminum to protect product color.

Detailed information on Alcoa aluminum for heat exchanger tubes is contained in booklet AD186, available on request.



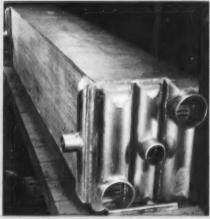
Fabrication of a group of all-aluminum heat exchanger bundles for the petroleum industry.



View during installation of a 35,000 sq ft aluminumtubed surface condenser in a steam power plant.



All-aluminum, water-cooled, finned-tube heat exchanger for conditioning air used in a large wind tunnel.



This brazed aluminum assembly, weighing nearly 900 pounds, provides heat interchange between five substances simultaneously.

Transfer and Storage

Process Piping

Alcoa aluminum pipe is used to carry liquids and gases in chemical, petrochemical, petroleum, and food processing plants. Aluminum pipe resists attack by the materials carried as well as by the corrosive atmosphere often encountered around such plants. The product is also protected from contamination or discoloration.

For most process applications, schedule 40 pipe is recommended. Aluminum pipe is available in all of the normally produced schedules.

Where resistance to corrosion or protection of product is an important consideration, Alcoa Aluminum piping is often the least expensive material that will do the job satisfactorily.



Alcoa Aluminum pipe is made in several weights and in a range of sizes in accordance with ASA Schedule Nos.

Unitrace*

Alcoa Unitrace is a steam-traced pipe which eliminates the expense of external jackets or steam traced tubes by making the steam line an integral part of the aluminum pipe. Users report savings of up to 30% in labor cost, plus important reductions in material and insulation costs.

Unitrace provides greatly improved heat transfer properties. Pre-formed insulation will fit Unitrace although its improved efficiency makes thermal insulation unnecessary in many cases.

Unitrace can be formed easily with conventional pipe-bending tools. The standard lengths are well adapted to shop fabrication.

More detailed information on applications and methods of using Unitrace are contained in bulletin AD418.

Utilitube*

Alcoa Utilitube is aluminum coiled tube made of a specially selected alloy which combines low cost, easy workability and high fatigue strength. It is used effectively in instrument air lines, hydraulic and lubricating lines, and refrigeration tubing.

Alcoa Utilitube has the excellent corrosion resistance typical of aluminum, along with high bursting strength and good mechanical properties. It is supplied in economical lengths of 1,000 feet or longer.

Alcoa Utilitube weighs only ¼ as much as copper tubing of similar capacity and costs up to 40% less.





Alcoa Utilitube is used as instrument air lines in many chemical and petroleum piants. Costing up to 40 % less than copper tube, Utilitube is available in 1000 foot lengths in certain sizes. Fittings for Utilitube are available from several suppliers.

Fittings and Valves

Where aluminum pipe or tubing is used, it is desirable to complete the system with aluminum fittings and valves.

Alcoa does not manufacture valves, but it does supply aluminum to other manufacturers who do. Your Alcoa representative can furnish the names of competent suppliers.





Unitrace section showing trace line cut back for joint.

Special cast Unitrace flange for simple, efficient joining of Unitrace sections.

^{*}Registered trademarks

Standard and Special Storage Tanks

Alcoa standard storage tanks, fabricated of 3003 alloy, are supplied in a number of sizes ranging from 580 to 21,400 gallons. They are available in both horizontal and vertical construction.

Made from stocked components, these standard tanks bring the user all the advantages of Alcoa Aluminum at lower cost and with faster delivery.

Special storage tanks to meet any requirements
may be constructed of Alcoa sheet and plate. In-

may be constructed of Alcoa sheet and plate. Information on design and fabrication will be furnished on request.



World's largest all-aluminum tank stands 26 feet high, has a diameter of 128 feet, holds 21/3 million gallons of 83% ammonium nitrate solution.



Alcoa Standard Tanks provide economical storage for a wide variety of chemicals.

Shipping Containers

Alcoa offers a wide variety of shipping containers conforming to ICC regulations. These containers range in size from 7½ to 110 gallons and are used for shipping such diverse products as beer and fuming nitric acid.

Alcoa aluminum containers are lighter in weight than containers of other suitable materials, are less expensive and give longer service.

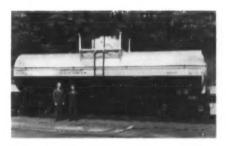


Tank Cars, Trucks, and Trailers

The use of Alcoa aluminum in tank cars and trucks provides important advantages in ultimate cost and flexibility.

Aluminum tank cars and trucks are used extensively for transporting ammonium nitrate, acetic acid, nitric acid, acrylonitrile, hydrogen peroxide, formaldehyde, glycerine, alcohols, and other chemicals, as well as petroleum products, dairy products, edible oils and rosins. For more detailed information on the behavior of aluminum with various products, refer to Process Industries Applications of Alcoa Aluminum.

The light weight of aluminum makes possible a higher ratio of payload-to-gross weight in highway trucks and trailers. The fact that aluminum is resistant to so many kinds of corrosive attack keeps maintenance to a minimum.





Plant Structures

Roofing, Siding, Structurals

Alcoa industrial building sheet is used for roofing and siding on plant buildings and to protect conveyors and other outdoor equipment. The aluminum surface requires practically no maintenance and lasts well even when exposed to corrosive atmospheres often encountered around processing areas. It is easily installed and helps to keep construction costs low

construction costs low.

Alcoa also supplies structural shapes for use in construction where their corrosion resistance and consequent low maintenance cost are advantageous.



Aluminum exterior surfaces for buildings and conveyors provide pleasing appearance with minimum maintenance.

Aluminum Paint

Alcoa manufactures high quality aluminum pigments which are used by leading paint manufacturers in aluminum paints. Aluminum pigment differs from ordinary paint pigments in that the particles are leaf-like rather than granular. As the paint is applied, these flakes of pigment arrange themselves in parallel layers, forming a continuous metallic sheet of pure aluminum, which provides unmatched protective power.

Aluminum paints are available in various types to meet all plant needs. Included are special silicone-base formulations for use on heated metal surfaces. These silicone-aluminum paints will not break down on surfaces that get as hot as 1000°F.



Towers, piping and other equipment in this petroleum processing plant are protected by aluminum paint.

Weatherproofing for Thermal Insulation

Aluminum sheet or foil jackets are frequently used to weatherproof thermal insulation. Such coverings protect the insulation from weather and wear, and, in special designs, may serve also as vapor barriers.

Aluminum sheathing weatherproofs thermal installation on towers, heat exchangers and piping at this natural gas treating plant.

Bus Bars

The excellent electrical conductivity of aluminum is employed advantageously in bus bars for use in process plants. Low cost per unit current capacity and good corrosion resistance are key advantages.



Rigid Conduit

Alcoa rigid conduit is light in weight and easily formed, simplifying installation. Its smooth inside surface makes for easy "fishing," and the well-known corrosion resistance of aluminum guarantees long life for the installation.

Grating and Tread Plate

Aluminum grating is used widely for floors and walkways in and around processing plants because of its light weight, resistance to corrosion and low maintenance requirements. Its nonsparking characteristic is an important safety feature in petroleum refineries, on tankers, and wherever explosion hazards are found. Check with your Alcoa sales office for names of suppliers.

Alcoa supplies both a standard aluminum tread plate and Alcoa abrasive tread plate. The latter has a bonded abrasive surface for extra nonskid protection.



Handrails

Stairs, walkways, platforms, and similar places require dependable protection for personnel. Handrails of Alcoa aluminum are light, strong, and dependable, and will remain safe and attractive with practically no maintenance.

Aluminum piping or extrusions can easily be fabricated into practical rails.

Chain Link Fence

Chain link fence made of Alcoa aluminum wire is extremely weather resistant and does not require painting even in saltwater exposure. Aluminum fencing is especially suitable for use around processing plants because it will provide long service with practically no maintenance.



Windows

Dimensional stability, resistance to weathering, ease of installation and operation, and attractive appearance are the principal advantages of aluminum windows.

Window frames are available in a wide range of standard sizes, and special sizes can be readily fabricated of aluminum extruded stock. Consult the nearest Alcoa sales office for names of suppliers.

Hoods and Ducts

Aluminum sheet is easy to fabricate by conventional sheet metal methods. This, along with its other desirable properties, particularly resistance to corrosion, suggests its extensive use for a wide variety of duct work in processing plants.



Fasteners

Alcoa supplies a complete line of rivets, nuts, bolts, washers, machine screws, sheet metal screws, and certain types of nails in most standard sizes and lengths.

The use of aluminum fasteners with other aluminum components is in accord with best engineering practices. The absence of corrosion assures cleaner, stronger, longer-lasting joints.

ALCOA Aluminas.. to improve processing

Throughout the process industries, versatile Alcoa® Aluminas are widely used to up-grade chemical reactions, speed processing and create better products at lower cost. Their high chemical purity combined with important thermal and physical characteristics makes them ideally suited to a broad range of applications in a variety of processes. There is a type and grade of Alcoa Alumina perfectly matched to specific process requirements in such diverse uses as these:

Catalysts and Catalyst Supports

Alcoa Activated, Tabular and Calcined Aluminas improve catalytic reactions in several ways. They permit close control of reaction rates. They substantially reduce carbon deposits. And they frequently lower operating temperatures. This results in increased catalytic process yields with substantial reduction of losses from contamination and side reactions... good reasons why it always pays to insist on ALCOA Aluminas for catalysts and catalyst supports.

Bed Supports and Covers

Alcoa Tabular Alumina Balls offer a perfect answer to the need for stable, noncontaminating bed supports and covers for catalysts and desiccants. Neutral, nonreactive and highly refractory, they keep catalyst contamination negligible . . . an important plus when they are used in reactors employing expensive catalysts. Alcoa Tabular Alumina Balls are available in several grades to fit varying thermal and mechanical requirements, and in sizes ranging from ¼" to ¾". Whatever the reaction process, they afford economy, adaptability and peak operation of reactor towers.

Drying Agents

Alcoa Activated Aluminas are synonymous with fast, efficient dehydration of liquids, gases and vapors. The oldest, most thoroughly proved commercial desiccants, they dry to lower dew points (minus 100°F and lower) than any other. They are uniform in purity, composition and structure. They are nontoxic and inert to most gases and vapors. Their particles are strong and do not break

down through repeated cycles of saturation and reactivation. Their relatively low cost and ability to stand up through almost endless reactivations make Alcoa Activated Aluminas the most economical solution to the problem of fast, efficient, dependable dehydration.

Refractories

Alcoa Aluminas used to fortify refractories enable them to withstand higher process temperatures longer. In fact, refractory performance increases in almost direct proportion to the amount of Alcoa Alumina used. These are the outstanding characteristics afforded by high alumina refractories: exceptional strength and stability under load at high temperatures . . . extremely high resistance to thermal and mechanical shock . . . extra resistance to spalling, abrasion and fluxing . . . unusually low porosity and shrinkage . . . extremely low coefficient of expansion. For longest satisfactory refractory service at highest temperatures, it pays to insist on refractories made of or fortified with Alcoa Alumina

Alcoa Aluminas offer efficient, economical solutions to a host of processing problems. Their performance is backed by years of painstaking research, laboratory testing and field experience. Complete data on their properties and applications is available from Alcoa in the technical paper, Alumina Properties.

Other Alcoa Chemicals include Gallium and Fluorides. Detailed information on their properties and applications is available on request.

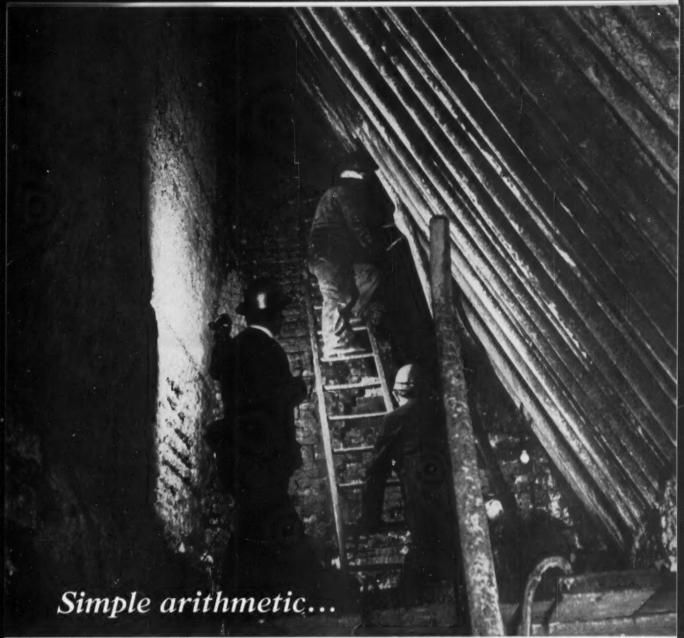
Alcoa's many years of experience and research have created a vast fund of practical information to assist you in solution of your processing problems. Alcoa's development engineers will be happy to work closely with you in solving such problems as . . . corrosion control . . . proper design and fabrication of aluminum parts and assemblies . . . most effective use of the proper type and grade of alumina for your process needs.

For engineering assistance—or for detailed literature covering any of the aluminum or alumina applications mentioned above—write Aluminum Company of America, 883-J Alcoa Building, Pittsburgh 19, Pennsylvania.









-Photograph courtesy of Standard Oil Co. of N. J.

with Ljungstrom® Air Preheaters, four of your present stills can do the work of five

You'll have far less slag—much less downtime for maintenance—with the Ljungstrom Air Preheater. This unit produces more complete combustion, at higher temperatures, because preheated air mixes more thoroughly with fuel. And in addition, Ljungstrom efficiency makes possible finer process control and advanced furnace designs. Thus, Ljungstrom savings are real and measurable. One still, Ljungstrom equipped, added \$58,000 of income annually from higher product quality alone.

How fast is "WRITE OFF"?

Unusually short. Major savings are gained from higher average octane ratings. And other Ljungstrom advantages—up to 20% fuel savings... more economical furnace design, with no need for convection surfaces... use of many

fuels you used to throw away...consistently higher throughput...shorter turnaround time—mean that a Ljungstrom is paid out in a very few months.

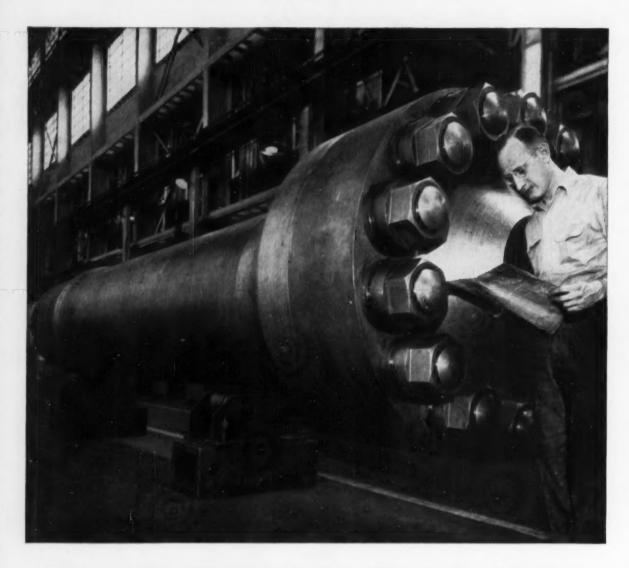
For more complete details on what the Ljungstrom Air Preheater can do for you...for an analysis of the heat recovery benefits attainable in fuel burning equipment—call or write the Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



Not a Featherweight, By Any Means

The forged vessel pictured here is as massive as it looks—and as strong. It's a Bethlehem-built converter with an ID of 30 in. and an OD of 45 in., and it weighs in the neighborhood of 48 tons.

A lot of work and steel went into this pressure vessel. Yet despite its bulk, it isn't as heavy as some of the units we've built. There are times when we're called upon for some awfully big ones.

Of course, not every Bethlehem vessel is king-

size. Many customers want the smaller, lighter types, which can weigh as little as four or five tons, or even less. These jobs are as welcome in our shops as the giants, and they receive the same expert handling throughout.

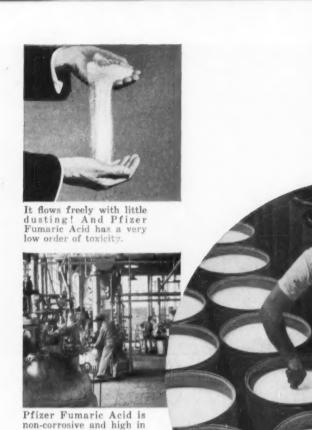
Whatever your needs in vessels, large or small, Bethlehem is equipped to serve you. Call us when planning autoclaves, filters, separators, converters, reactors, or high-pressure accumulators.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL





Now, a fine granular form of

PFIZER FUMARIC ACID

• Pfizer now offers you fumaric acid in a choice of two mesh sizes. This means a fumaric product tailored to your needs...one that speeds production of your alkyd resins and polyesters.

purity. It's kind to resinproducing equipment.

The fine granular form of Pfizer Fumaric Acid is exceptionally uniform, flows more freely and dusts far less than standard fumaric acid products.

The powder form of Pfizer Fumaric Acid gives

very even distribution and blending, settles out less when a fine-particle size is needed.

Look to Pfizer as a dependable source for highquality fumaric acid—a non-volatile, odorless, noncorroding and nontoxic acid that rates tops with the coatings industry. Write us if you'd like a free sample of either the fine granular or powder form of Pfizer Fumaric Acid.

Manufacturing Chemists for Over 100 Years



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Chemical Sales Division

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stainless steel holds the answers

Every industry that works with steel has its special problems of the proper steels for every job . . . more and more industries are finding that Stainless "holds the answers" to their problems.

Take the petroleum and chemical industries for instance. They demand resistance to corrosion, to abrasion, high temperatures, cold temperatures, scaling and hydrogen blistering. Solid stainless can do the job. But, in some equipment, stainless cladding can answer the problems . . . and cut costs as well.

Sun Ship knows how to fabricate stainless and the other special alloys. They have the facilities and experience. Large jobs or small jobs will receive prompt attention.

Our Sales Engineering Department will be glad to discuss with you any problems to which our Alloy Products Shop may hold the efficient and economical answer.



ALLOY PRODUCTS SHOP

OF SOM SHIPBUILDING & DRY DOCK COMPANY

Five New and Impro

Wayne ROTARY PUMPS

Quiet, long-life, high-efficiency rotary pumps for every industrial application . . . all thoroughly pretested for handling alcohol, asphalt, brines, caustics, chemicals, dyes, fruit juices, gasoline, greases, lacquer, oils, starch, sulphuric acid and other products of varying weights and viscosities. These five pumps will efficiently handle all:

SERIES A-Standard Duty High and Low Speeds-for operating pressures under 125 psi.

SERIES B-Standard UL Approved-for pumping hazardous liquids.

SERIES C-Rugged Duty Packed-for medium or high viscosities at operating pressures up to 200 psi.

SERIES D-Rugged Duty Sealed-for liquefied gases and other fluids of very light viscosity.

SERIES E-Rugged Duty Steam Jacketed-with steam jacket, for high viscosities.

These new Wayne Pumps give positive action and higher volumetric efficiency. Have only two moving parts-the driver rotor precisely balanced in the casing, and the idler-with Wayne's exclusive rolling gear circular tooth design. With a Wayne you can pump the same GPM with smaller, lighterweight unit.

THE WAYNE PUMP COMPANY

Industrial Division . FORT WAYNE, INDIANA



POSITIVE DISPLACEMENT DESIGN

- 1. Liquid is drawn into pump by suction created when pumping elements are disengaged.
- 2. Crescent acts as valve, preventing backflow.
- 3. Fluid is forced out discharge port as pumping elements re-engage.



PUMP SELECTOR GUIDE

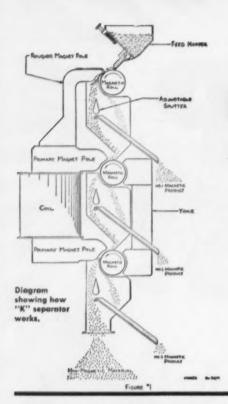
Send this coupon for FREE new and novel PUMP Selector Guide

THE WAYNE PUMP COMPANY Ind. Div. . FORT WAYNE, INDIANA

Please send my free copy of new "Pump Selector Guide."

TITLE

COMPANY_



FEATURES THAT PUT THE "K" OUT FRONT:

Magnetic field protected against flux leakage

Magnet support frame is not part of magnetic circuit. Specially constructed steel rolls with non-magnetic stub shafts further insulate magnetic circuit.

2. Simple adjustment

Positive, easy control of feed rate, air gap width, splitter settings for extremely accurate separation. So simple, unskilled workers can operate and adjust it.

3. Uniform material distribution

Louver-type feeder provides uniform distribution across entire feeder width. Speed of feed closely matches roller speed for greatest efficiency.

4. Powerful magnetic force

Primary pole noses are scientifically shaped to give maximum flux density in separating zone—take full advantage of powerful electro-magnetic force.

5. Dependable, long-lasting

Triple-sealed bearings keep out dust, insure smooth, low-cost operation. All parts are easily accessible for service.

Here are same products the "K" handled profitably:

Feldspar

Silica Sand Scheelite Soda Ash Silicon Carbide Aluminum Oxide Fire Clay Kyanite Phosphate & Derivatives

Dolomite Bauxite Magnesite Sodium Sulphate Fluorsper Sodium Sesquicarbonate Sodium Carbonate

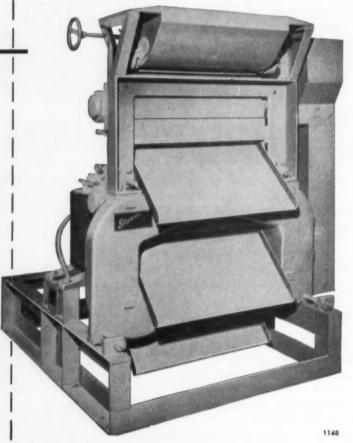
Nepheline Syenite

Purifies and concentrates Bulk Chemicals where other methods fail

STEARNS HIGH-INTENSITY MAGNETIC SEPARATOR

Stearns Type K magnetic separator provides an intensely powerful magnetic field which attracts very feebly magnetic particles. That is why the "K" has proved highly successful in purifying and concentrating chemical products when other methods were either impractical or inadequate.

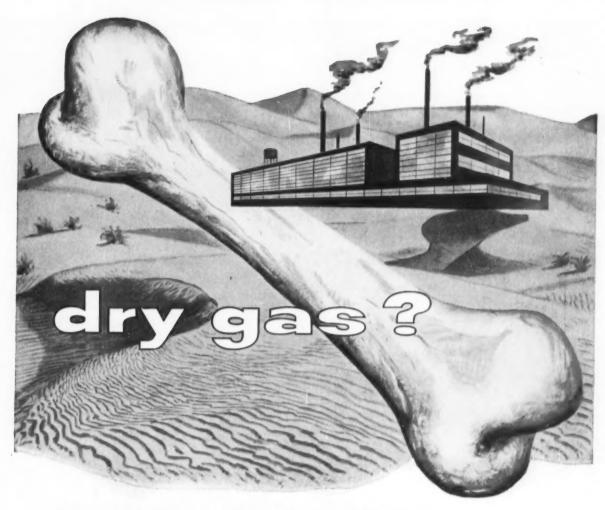
Users report that this separator has given outstanding results for magnetically cleaning or concentrating materials ranging in size from 10 to 200 mesh. Capacity ranges from 80 to over 500 lb per hr per inch of feed width. "K" separators are built in 10, 20 and 30-in. feed widths and can be furnished with from 2 to 7 magnetic fields. Complete laboratory facilities available for testing samples of your product. We invite comparison of results. Write today for bulletin 701B,





STEARNS MAGNETIC PRODUCTS

of the indiana site products company + valparaiso, indiana 629 South 28th Street + Milwaukee 46, Wisconsin

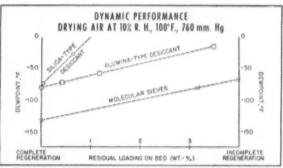


Now you can dry gases drier than dry!

LINDE Molecular Sieves can dry your gases—air, hydrogen, chemical streams—more thoroughly than any other commercial adsorbent. They will duplicate laboratory performances—in your plant—under normal production conditions.

Even though your gas stream may already be partly dried, Molecular Sieves will remove the last traces of moisture. Only a small volume of adsorbent is required. The same combination of high capacity and low dewpoint is also obtained at high temperatures, up to 200°F.

This is SUPER-drying! Dynamic performance is shown in the accompanying graph. This superior performance also can be expected at higher relative humidities and at other temperatures and pressures. Of particular significance in production is the relative insensitivity of Molecular Sieves to incomplete regeneration.



For further information, write for data sheets on "Drying of Gases." Address Dept. CG-9, Linde Air Products Company, A Division of Union Carbide and Carbon Corporation, 36 East 42nd St., New York 17, N. Y.



The term "LINDE" is a registered trade-mark of Union Carbide and Carbon Corp.

One of a series factoring various breast and sixes of Chicago Possessitic Compressors.

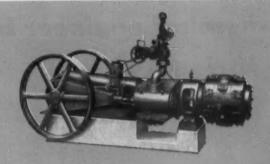
CP steam-driven

- For pressures to 15,000 PSIG
- · Sizes up to 1250 H.P.

Chicago Pneumatic

AIR AND GAS COMPRESSORS . VACUUM PUMPS . PNEUMATIC TOOLS . ELECTRIC TOOLS . DIESEL ENGINES . ROCK DRILLS . HYDRAULIC TOOLS

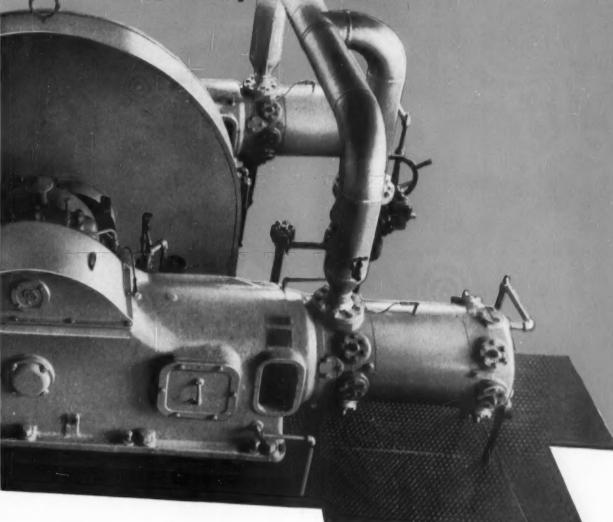
September 1956—CHEMICAL ENGINEERING



Class T single-stage, herizental, straight-line, steam-driven compresser. Also available in tweand three-stage designs.

compressors

... for the process industries



Class H, four-corner, steam-driven, single-stage gas booster compressor.

Must a chemical engineer be a filter fabric expert, too?

The development of new filter media has certainly widened the choice. But this wider choice has also complicated the job of selecting the right media, and made it more exacting.

Orlon, nylon, dynel, Dacron, cotton—which fabric for your filter? Does your filtration problem demand greater abrasion resistance?

Resistance to alkalis and acids?

Heat? Is blinding a production headache?

These and other problems call for detailed, specialized knowledge of all filter media and their individual capabilities and limitations. But you, the chemical engineer, don't have to know all the ins-and-outs of fiber, yarn, construction, use. Particularly because you can call on the knowledge of specialists who distribute our filter fabrics, and the century of Wellington Sears experience behind them. To put this "team" to work on any filtration problem you may have, just call us. For names of distributors and free copy of "Filter Fabric Facts," write Dept. L-9.

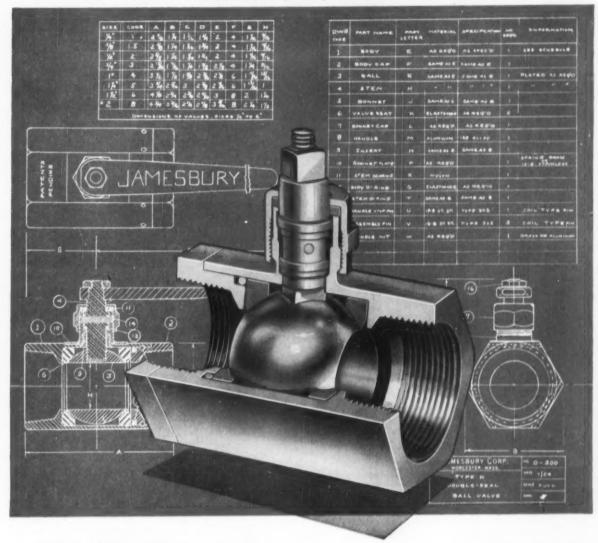
ellington Sears

FIRST In Fabrics For Industry

65 Worth Street, New York 13, N. Y.

Offices in: Atlanta . Boston . Chicago . Dallas . Detroit . Los Angeles . Philadelphia . San Francisco . St. Louis

New, all-stainless double-seal ball valve. Its manufacturer, JAMESBURY CORPORATION, Worcester, Mass., stresses its straight-line flow and elimination of practically all maintenance.



STAINLESS means corrosion-resistance in new double-seal ball valve...

The all-stainless construction of this new-type, double-seal ball valve means exceptional resistance to corrosion, erosion and abrasion. That's part of the reason why these Jamesbury valves are being used for chemical applications...processing of hot caustic solutions...even for the vacuum fields.

The valve differs from conventional globe or gate valves in that its operation depends upon a stainless steel ball, sealed with a plastic or rubber ring on both sides. All of the valve, including the ball, is machined from Crucible stainless bar stock, type 303 or 316.

Stainless may be the answer for your product, too. Why not let a Crucible engineer give you the facts concerning its most profitable use? Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.

CRUCIBLE

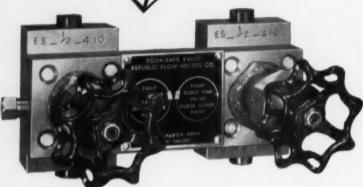
first name in special purpose steels

Crucible Steel Company of America

CHEMICAL ENGINEERING—September 1956



Damage to
Differential
Bellows
and Diaphragms



- CANNOT throw full line pressure across bellows, mercury or diaphragms of △P instruments.
- Replaces 3 or 4 conventional shut-off valves, fittings, etc.
- Rated to 4000 psi (cold)
- Available with angle, 3-way or through-type bodies threaded or socket- welded connections.

No conventional built-up valve manifold affords the protection EQUA-SAFE automatically gives to differential pressure type instruments. And no built-up valve manifold can beat the low installation time or low maintenance required by EOUA-SAFE valves.

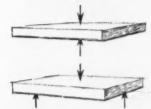
The "secret" of EQUA-SAFE's protection is in the common bridge-type bonnet and the two double-seating valves it connects. When either valve is operated (and sequence does not matter) pressures in the two chambers of the differential instrument are automatically equalized through the bonnet. As soon as both valves are fully "opened" (stem out) the instrument is on the line, with no leakage between sides. When both stems are in, the instrument chambers are interconnected and completely sealed off from primary connection pressures. Teflon packings are under pressure only while the stems are traveling from "seat" to "backseat", or vice versa!

Standard EQUA-SAFE valve manifolds are made of carbon and/or stainless steel, depending on your requirements. If your requirements are unusually severe, remember that EQUA-SAFE valves can be made of any bar stock material that can be machined and welded! When inspection or maintenance are needed, this bolted-block construction pays off again. EQUA-SAFE valves can be completely dismantled without breaking any pipe connections, and the inlet seat can be dressed up in place. A reversible backseat ring gives double wear, and is merely turned upside down to present a brand new seat.

Get the entire story on what EQUA-SAFE valves can do for your differential instrument installations. Write for Republic Bulletin No. 56-1, or ask your Republic engineer. Now that there is a top-quality instrument valve manifold for ΔP instuments, you should definitely investigate its applications in your plant.

REPUBLIC FLOW METERS CO.

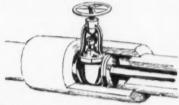
2240 Diversey Parkway, Chicago 47, Illinois



Unequaled compressive and flexural strength!



Saw it ... nail it ... shave it ... drill it!



Bridge joints and fittings without fear of breakage!

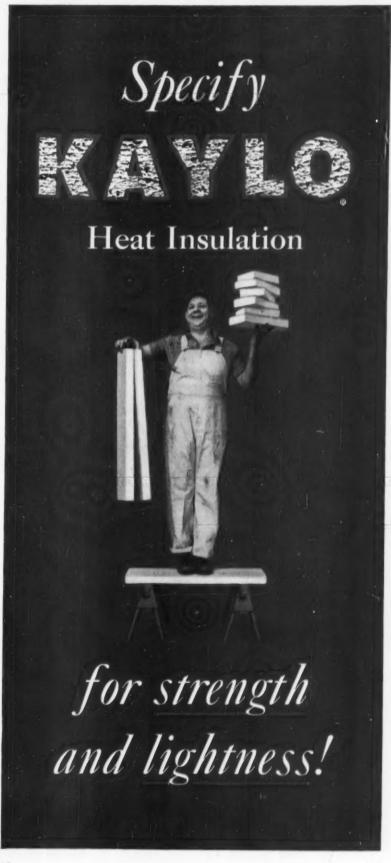
KAYLO® and FIBERGLAS*

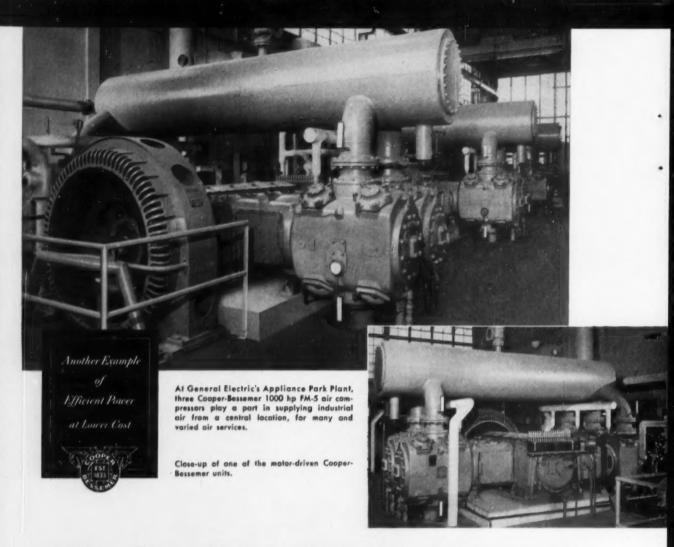
INDUSTRIAL INSULATIONS

... distributed by approved Fiberglas distributor-contractors... offer the most versatile family of plant insulations available. With new pink Kaylo-20 (increasing the upper range of Kaylo by 600° F.!), you can now order—from one reliable supplier—complete insulation coverage from lowest sub-zero to 1800° F., serving such extra-high temperature applications as catalytic cracking units, refractory wall backing for furnaces and boilers, and fireproofing of piping, equipment, and vessel skirts. See Sweet's Files, Chemical Engineering Catalog or Refinery Catalog. Or write Owens-Corning Fiberglas Corporation, Dept. 97-I, Toledo 1, Ohio.

FIBERGLAS

OT.M. (Rag. U.S. Pat. Off.) Owens-Corning Fibergias Corporation T.M. Rag. Owens-Himolo Glass Co., Inc., mfr. of Kaylo





AIR...from Cooper-Bessemer Compressors for modern production at Appliance Park

 At General Electric's new Appliance Park Plant in Louisville, where these Cooper-Bessemer 1000 hp air compressors are at work, they've concentrated the manufacture of various appliance lines in this one giant plant. The object is highest efficiency in quality production at the lowest manufacturing cost.

The Cooper-Bessemer units, meeting all of the many and varied compressed air needs, fit in ideally with this policy of concentration, efficiency and minimum cost. Installed in a centrally located building, these modern two-stage, opposed balance compressors provide a dependable source of air, yet occupy minimum area. And, being well balanced, they require less foundation than was possible with older type machines.

If your plans call for compressed air on a longterm basis, find out about the extra advantages you'll get with Cooper-Bessemer. They range from 100 to 5,000 horsepower; save space, housing installation and piping costs . . . without sacrificing flexibility, ruggedness or accessibility.



New York City * Seattle, Wash. * Chicago, Ill. * Houston, Dallas, Greggton, Pampa and Odessa, Texas * Washington, D. C. Shreveport, La. * San Francisco, Los Angeles, Calif. * St. Louis, Mo. * Gloucester, Mass. * New Orleans, La. * Tulsa, Okla. Caracas, Venezuela * COOPER-BESSEMER OF CANADA, LTD., Edmonton and Calgary, Alberta, Canada.

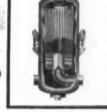
KEEP IT CLEAN...

by Phil Tration



To say that every pipe line needs a Dollinger filter is certainly an exaggeration. However, if you want to filter liquids of any kind, nothing does the job better than the Model ELS Liquid Filter illustrated at the right.

The world-wide use of Dollinger filters on thousands of liquids is proof of their adaptability to practically any requirement. All known filtering materials are available for any problem regardless of temperature, pressure, or corrosion factors. And, all Model ELS Liquid Filter MODEL ELS (PRESSURE)
LIQUID FILTER



bodies are available in steel, stainless, monel, herculoy and other non-corrosive metals. Construction can be according to ASME or API Code specifications.

Send for 12-page Bulletin 300. It contains illustrated data and recommended uses of Dollinger Liquid Filters. Dollinger Corporation, 4 Centre Park, Rochester 3, N. Y.

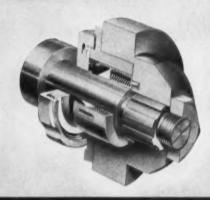
DOLLINGER STAYNEW FILTERS

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS ELECTROSTATIC FILTERS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • MIGH PRESSURE FILTERS AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS NOW

MINIMUM LEAKAGE PUMPING CORROSIVE SOLUTIONS . . .



with a Waukesha Pump...
using a John Crane Seal

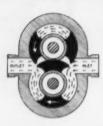


Note, too, these other outstanding pump features to speed plant production and lower operating

316

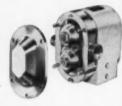
Positive Displacement and Slow Speed

No product damage ... no aeration ... no agitation.



Sturdy Construction

Designed for long life, a minimum of maintenance.



Corresion-

No product contamination . . no impairment of flavor.



Sanitary

Easy to clean, especially when changing product runs while using the same pump.



• Designed for a "tough" pumping job in the chemical industry, where volatile, corrosive, or hot materials are being transferred, is the Waukesha positive displacement pump with the spring-loaded, John Crane Rotary Seal. Incorporating carbon, ceramic, and teflon, this seal is recommended for nonabrasive products having corrosive properties.

Waukesha positive displacement, corrosion-resistant, stainless steel pumps are renowned for their precision performance and dependable operation in many industries. These pumps require a minimum of time to dismantle, clean and assemble. They are easy to wash and sterilize... a valuable asset where pumps are used to handle various products one after another. Write the Waukesha Foundry Company, Dept. 9P, Waukesha, Wisconsin, for complete details.



WAUKESHA-

the forward look in pumps.
Yesterday, Waukesha pioneered the
Sanitary P. D. Pump. Today, Waukesha
pioneers the improvements.



for laminating and coating

SHELLWAX® ... fully refined paraffin waxes

Available in a wide melting point range (125-180° F.). These are highly stable with negligible oil content. They provide coatings with high gloss and excellent resistance to water vapor transmission.



SHELLMAX® ... microcrystalline waxes

A range of refined microcrystalline waxes for laminating and coating. The laminating grade has excellent adhesive qualities, is flexible and tough. The coating grade is relatively hard and possesses high blocking characteristics.

Both Shellwax and Shellmax have been thoroughly proven in industry for a wide variety of applications.

SHELL OIL COMPANY

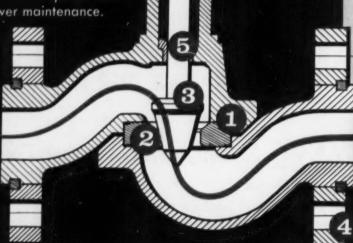
50 WEST SOTH STREET, NEW YORK 20, NEW YORK 100 BUSH STREET, SAN FRANCISCO C, CALIFORNIA

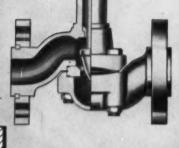


ANNIN BODY DESIGN enhanced

SOLVE COMPLEX PROBLEMS OF FLUID CONTROL..

- Reduces body turbulence and erosion.
- Longer seat ring life retains tight closure.
- High lift in all sizes for better control - greater rangeability.
- Fewer parts simplified and much lower maintenance.





GLOBE BODY

parts inventory and maintenance.

- BODY. The split body construction provides single seat design which retains internal contour of the same area as relating pipe size . . . eliminates pockets and shoulders . . reduces erosion.
- SEAT RING. The body flanges retain seat ring in perfect alignment with valve plug. The valve seat is not affected by stresses from pressure or thermal shocks.
- 3 VALVE PLUG AND STEM. Valve plugs are contoured to provide either linear, percentage, or semi-throttle characteristics. Elimination of wings, or skirts, reduces turbulence, wire drawing, plug vibration and noise.
- SEPARABLE FLANGES. Can be interchanged at will. Carbon steel flanges can be mounted on alloy bodies for econ-

omy. Integral flanges are available where special flange facings are required.

PLUG GUIDE. Hard metal guides of close tolerances can be inserted through stuffing box without resorting to threads, welding, pressing or staking. Interchangeable with Teflon guide bushing.

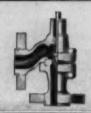
The Soundest Approach to Fluid Flow Control

Annin Valves have proven to be the answer to the complex fluid control problems common in the process industries-Chemical, Petroleum, Paper, Steam, Power Plants, and many others. Today, Annin Valves are recognized by control engineers and valve designers as the outstanding valve development of the past twenty-five years for the control of hot, cold, erosive, or viscous liquids.

OTHER BODY DESIGNS PROVIDE FLEXIBILITY IN INSTALLATION



CORNER BODY



ANGLE BODY



3-WAY VALVE -ANGLE ADAPTER



3-WAY VALVE-GLOBE ADAPTER

with ANNIN VALVE OPERATORS

ASSURE PRECISE VALVE RESPONSE & RELIABILITY



DOMOTOR

The Domotor® operator is the most responsive, precise positioning, and lastest pneumatic operator available. It brings to automatic control new performance, positioning accuracy, speed and finest response.



PRESSURE BALANCED

For accurate pressure control of air and gases at pressures to 300 psi and temperatures to 1200°F.

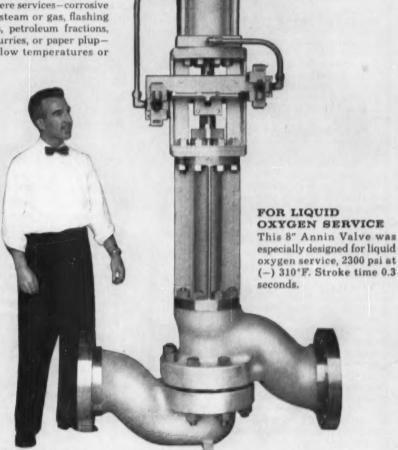


MANUAL

Particularly adaptable to Annin Valve Body design for manual by-pass service, manual flow control for batch and other non-continuous operations

ANNIN Control Valves meet design requirements for the most exacting service conditions

Annin Valves have no equal in the handling of all types of fluids or gases in severe services-corrosive chemicals, steam or gas, flashing condensates, petroleum fractions, chemical slurries, or paper plupat high or low temperatures or pressures.



ANNIN'S complete line of control valves will be on display in booths number 1408 and 1409, 11th Annual Instrument-Automation Conference and Exhibit.

Send for your copy of Annin's entirely new and comprehensive valve catalog 1500-C.





LIFT CHECK VALVE

Available in all standard pressure ratings to provide positive, safe prevention of flow reversal.

THE ANNIN COMPANY
6570 EAST TELEGRAPH ROAD, LOS ANGELES 22, CALIFORNIA

Control VALVES

How to increase the throughput of a filter

Filter aids are used primarily in systems in which the filterable solids tend to form an impermeable layer of slimes on the filter cloth, thus choking off the flow. Tests have shown the resistance of a cake of filterable sugar solids may be as much as 10,000 times that of a good filter aid filter cake. Filteralds perform the useful function of reducing the resistance, thus increasing the rate of flow through a filter.

There are a number of ways in which throughput can be increased. In general, the coarsest (most permeable) filteraid should be used that will provide a satisfactory degree of clarification. Filtration tests under controlled conditions in the laboratory will determine within a few hours the correct grade of filteraid for any given system.

Second, the filteraid should be used at its optimum concentration. Adding filteraid in increasing increments in any given system, produces very substantial increases in flow up to a certain point. Above this optimum percentage, further increases in flow are much reduced. In fact, in many systems the addition of too much filteraid will result in a definite decrease in throughput.

A third important factor in flowrate is the use of the maximum pressure consistent with the nature of the solids being filtered. Diatomite filteraids usually produce a relatively incompressible cake, so that increases in pressure result in increased flow. However, in a comparatively few systems, usually involving high solids of gelatinous nature, the addition of sufficient filteraid to render the cake incompressible is uneconomic. In these cases the pressure which affords the best balance between economical use of filteraid and the desired throughput should be determined by test.

A fourth method of increasing throughput is ordinarily recommended only under emergency conditions - that is, to "shortcycle" the press. Because the filtration rate of any filtration drops off rapidly as the cake thickness increases, it follows that a higher average filtration rate may be obtained by arbitrarily shutting off the press while the cake is still relatively thin, discharging the cake and starting a new cycle. Short-cycling may actually double the output of any given filter station-BUT-can be accomplished only with increased labor costs. However, it is sometimes useful when changes in process or unusual production requirements demand higher throughput on a temporary basis until additional filtration capacity can be installed.

Because of the influence on filtration rate of a number of process variables that cannot be covered in this brief outline, it is suggested that you insist on good technical service from your filteraid supplier. The services of our experienced filteraid engineers will enable you to secure maximum performance from your filteraid and maximum value for your filteraid dollar.

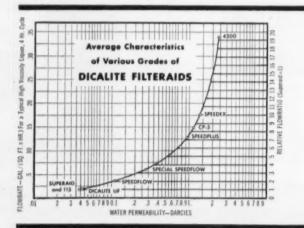
Paul W. Leppia, Technical Director



... is easy with

DICALITE FILTERAIDS!

... it's easy because the various grades of Dicalite filteraids afford such a wide range of filter throughput. When the output of your filter station matches production demands, you have no worries. But when sudden peak demands call for a sharp increase in filter output, you can use one of the four ways discussed in the column at the left—keeping in mind the flowrate range of the various Dicalite grades shown on the chart below. Again, should your process liquor vary in filterability from one day to another (as happens in many industries), you can maintain both quality and production either by varying the amounts of Dicalite fed to the filter, or by the use of another grade of Dicalite. One way or the other, you'll always have the right combination when you filter with Dicalite.





DICALITE DIVISION • GREAT LAKES CARBON CORPORATION 612 SOUTH FLOWER ST., LOS ANGELES 17, CALIFORNIA



2,048 Tons per Day

Chemical and fertilizer plants far and wide report exceptional satisfaction with the performance of the new "PAYLOADER" models. They not only handle more tonnage than earlier "PAYLOADER" machines, but are way ahead of other front-end loaders in design and the features which make them MORE PRODUCTIVE.

Whether you have a large-tonnage application like the one pictured*, a boxcar unloading need, or applications in between — indoors or outdoors — there is a "PAYLOADER" size to fit your requirements. And there is a nearby Hough Distributor with complete sales-service facilities ready to work with you.

*A 4-wheel-drive "PAYLOADER" with 2 cu. yd. hucket loading trucks with 256 tons of sulphur per hour.

Dig More—Powerful 40° bucket tip-back at ground level gets heaped loads quickly and easily with less spillage loss.

Carry More—Low, close load-carry position, plus hydraulic load shock absorber permit carrying more at higher speeds.

Deliver More—Since they get more to begin with and can carry more—at higher speeds—they deliver more tonnage, at lower cost.

THE FRANK G. HOUGH CO.

754 Sunnyside Ave., Libertyville, III.

- Send data on Model HA (18 cv. ft.)
- Send data on Model HAH (1 cu. yd.)
- On larger models up to 21/4 cu. yd.

Name____

Title_

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Company

Street

State

TA HULL

PAYLOADER

THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.

engineered by Blaw-Knox... a 24-hour fire guard Blaw-Knox Automatic Fog Systems, engineered to your special hazards, are fire guards that work for you 24 hours a day, every day in the year.

Blaw-Knox fire protection systems carry approvals of all insurance underwriters.

 Deluge Systems • Wet Pipe Systems • Dry Pipe Systems • Water Spray and Fog Systems • Rateof-Rise Sprinkler Systems • Foam and Carbon Dioxide Extinguisher Systems

> "Little Joey Sprinkler" always on the job



50 Meniversary

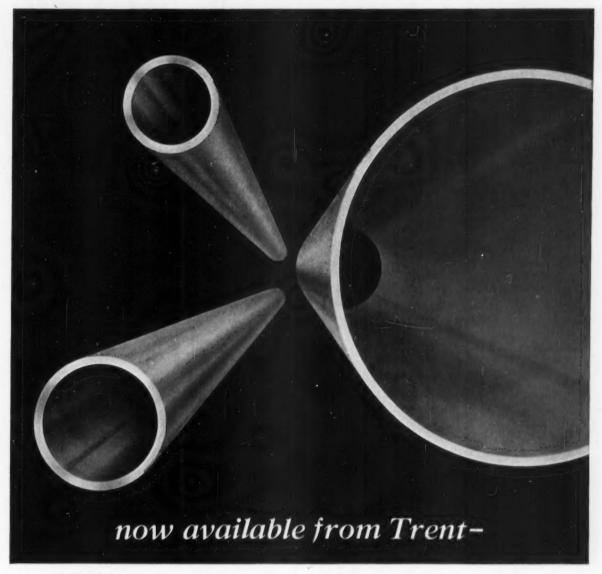
If fire should strike, your Blaw-Knox fire protection system will smother flames and dissipate heat quickly, thus checking possible loss of equipment and lives. It will also save you from such "hidden" dangers as loss of profits during downtime and loss of customers, possibly forever.

Blaw-Knox engineers have wide experience in water fog protection of chemical installations. We will gladly submit a layout and cost estimate of your requirements at no obligation. Why not call us today?

Send for a copy of our booklet, "Fire Can Destroy Your Business." You'll find it full of interesting facts.

BLAW-KNOX COMPANY

Automatic Sprinkler Department / Pittsburgh 33, Pa.



Titanium Tubing

For processing lines carrying fluids of an extremely corrosive nature — look to *Contour Trentweld* titanium tubing for reliable service.

This titanium tubing is completely uniform throughout any cross-section. The weld zone is free from bulging weld bead because Trent's exclusive process — performed with the weld area at the bottom — forms the molten weld metal into the shape of the tubing.

And, with titanium, you get the unique advantages of a tubing that's strong as steel but 44% lighter . . . virtually immune to a broad spectrum of corrosive materials . . . entirely free from stress-corrosion cracking.

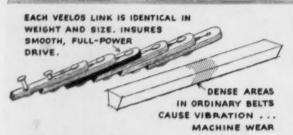
So, next time you need a strong, light, extremely corrosion-resisting tubing—try Contour Trentweld titanium tubing. And remember, it's made by Trent—tube mill specialists.



Stainless and High Alloy Welded Tubing

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of Crucible Steel Company of America)

Six Reasons Why Veelos Adjustable V-Belts **Are Better For Your Drives!**

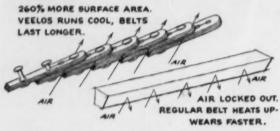


1. Balanced construction of Veelos Belts assures you faster, cleaner work, less rejects . . . less bearing wear. Each link and stud is identical in size and weight. Ordinary belts have varying spots of density which cause excess vibration-chatter marks, machine wear.

STROBE LIGHT PIN-POINTS CAUSE OF COSTLY VIBRATION IT - MEASURE IT -ELIMINATE IT

MEASURES VIBRATION DOWN TO 2 MULIONTHS OF AN INCH. COMPARES THE DIFFERENCE, YOUR ENDLESS BELTS-AGAINST

2. Electronic proof-up to 90% less vibration! With vibration analyzer, you see, on your own machine, how Veelos belts decrease vibration up to 90% over any belt you're now using. This amazing Veelos test pin-points the belt that has the "invisible shakes."



3. Cooler running—long life! Veelos breathes! Constant circulation of air keeps Veelos running smooth. Regular V-belts have no chance to cool, heat builds up from the inside . . . causes slippage, wastes power, heats bearings, reduces belt life.



PERFECT VEELOS FIT. EXTRA THICKNESS AND MACHINE-CUT SIDES PREVENT BOTTOMING, MEAN CONSTANT POWER



POWERLESS POINT CONTACT OF ORDINARY V-BELT. BULGES, SLIPS, CAUSES UNEVEN SHEAVE WEAR.

4. Greater flexibility reduces slippage! Sectional construction, beveled links allow greater flexibility, longer belt life. Each link moves around sheave independently and maintains full contact, constantly. Full area contact allows shorter centers, smaller sheaves.



NO DOWN-TIME. VEELOS FITS ANY DRIVE - WITHOUT DISMANTLING.



EACH VEELOS BELT CAN BE ADJUSTED - NO NEED FOR EXPENSIVE MATCHED SETS.

5. Simple installation "knocks out" down-time! Saves up to 50% installation time on outboard bearing drives, more when belt length isn't in stock. No resetting, tilting or moving motors. Veelos can be made any length, can be changed by adding or removing links.



MEASURE VEELOS I" SHORT PER FOOT AND FORCE ON DRIVE BY ROLLING. IT WON'T STRETCH.

6. Veelos won't stretch any more than ordinary endless V-belts when it is properly installed. Remember measure Veelos 1" short per foot and roll on drive as tightly as possible. With the first few revolutions Veelos studs accept a permanent set into the sections they connect.





outside U.S.A.

STATIC-CONDUCTING

Write for free Veelos Data Book or **Veelos Vibration Demonstration to:**

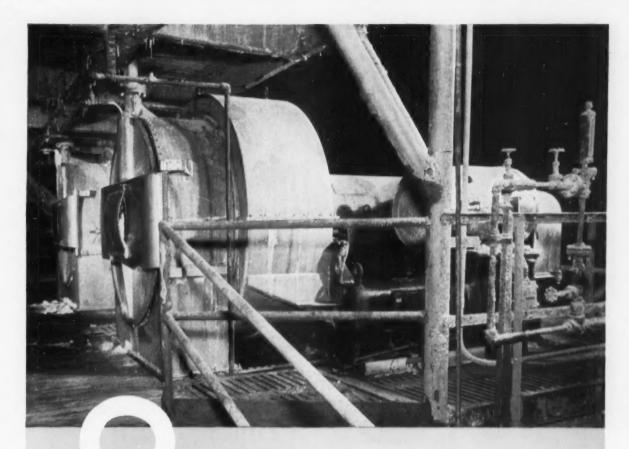
MANHEIM

Manufacturing & Belting Co. 410 Stiegel St., Manheim, Pa.

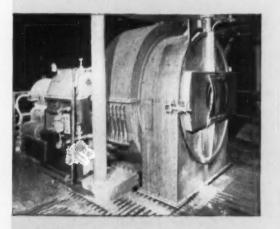
"Industrial Belt Specialists Since 1911



COATED



Eight years of troublefree centrifugation of ammonium sulphate with BAKER PERKINS continuous type centrifugals



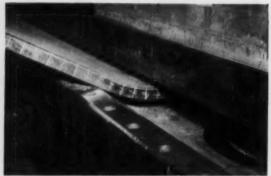
Installed at a plant of Phillips Petroleum Company's subsidiary, Phillips Chemical Co. in Pasadena, Texas, where they are separating ammonium sulphate slurries for fertilizer, each of these two Baker Perkins Continuous Centrifugals is producing 24-30 tons per hour of solids. One of the B-P "ter Meer" units went into service in August, 1948, eight years ago, and the other a few months later, yet during all that period of steady use only routine maintenance was necessary. They are both B-P Type S Size 48 Continuous Centrifugals, designed for centrifuging relatively free-draining crystalline, granular, and fibrous materials.

The Type S is particularly suited to handling friable material because it contains no scrapers, baffles, rakes, or plows to cause crystal disintegration. Constant speed drum rotation requires very low power input. All Baker Perkins "ter Meer" Centrifugals are truly continuous, needing no timing or cycle controllers for feeding or other action. If you would like more information on our Type S, Type HS (for filterable fine slurries) or Type HF (for non-filterable slurries or liquid-liquid mixtures), write for our illustrated catalog.

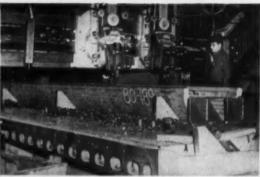
BAKER PERKINS INC.

CHEMICAL MACHINERY DIVISION SAGINAW, MICHIGAN

FOSTER WHEELER FABRICATES STEEL STEEL



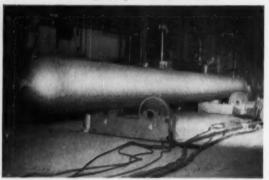
Bending 2 in."T-1" steel plate on 8000-ton beam press



Machining mating surfaces of half shell



Automatic welding of exterior seam



One of nine vessels nearing completion

THE FORMING and welding of highyield-strength "T-1" steel has been extensively investigated by Foster Wheeler and a number of pressure vessels have now been successfully fabricated of this new material. Operations in the manufacture of one of these vessels are shown above.

The 8000-ton beam press at Foster Wheeler's Mountaintop, Pa., plant was used to form the flat "T-1" steel plate, 2 in. thick, into half shells which were

machined and welded into a full cylinder. Bending techniques were developed and conservative limits established to control maximum bending stresses. The toughness of the steel was unaffected by cold bending within these established limits.

After exploring several welding processes, the automatic submerged melt technique was found most satisfactory, meeting the required joint efficiency of 100 percent in the stress

relieved condition.

For end closures, where inside back welding could not be used, a procedure was developed for 100 percent penetration welding without backing strips.

Foster Wheeler's specialized experience and extensive shop facilities are available for the heavy fabrication of "T-1" steel or other high-yield strength steels. For further information, write to Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.

FOSTER WHEELER

NEW YORK . LONDON . PARIS . ST. CATHARINES, ONT.

65-year test

directs choice of valves for new Rochester home of

WILMOT CASTLE COMPANY



JENKINS VALVES

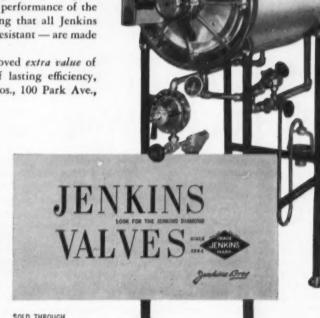
qualify on long record of reliable performance as standard equipment on Castle Sterilizers since 1890.

The Wilmot Castle plant at Rochester, N. Y., completed in 1955, was planned with the same exacting standards applied to design of Castle's fine products — sterilizers and surgical lamps for hospitals, laboratories, and the medical and dental professions.

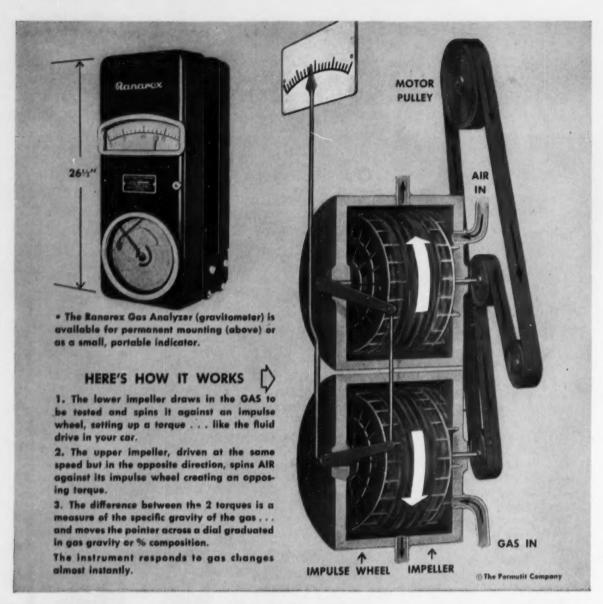
In selecting valves for the plant, the company could depend on their long experience with the faultless performance of the valves used on Castle Sterilizers, recognizing that all Jenkins Valves — bronze, iron, steel, and corrosion resistant — are made to the same high standards.

For both plant and product, the time-proved extra value of Jenkins Valves is dependable assurance of lasting efficiency, safety, and operating economy. Jenkins Bros., 100 Park Ave., New York 17.

THE HOSPITAL LABORATORY AUTOCLAVE illustrated is one of the many types of Castle Sterilizers used in hospitals and laboratories, and shows typical use of Jenkins Valves on the steam, water supply, and drain lines. Valves are renewable composition disc type, and have special heat-resistant, non-staining Bakelite handles, with each valve's function meulded in the top. Jenkins Valves provide the sturdy construction, safety, and good appearance required. They also permit quick, easy maintenance, since the renewable discs, made also by Jenkins Bros., are available anywhere from Jenkins Distributors.



SOLD THROUGH
PLUMBING-HEATING
AND INDUSTRIAL DISTRIBUTORS



"Fluid Drives" Weigh Gases at Low Cost

Look again at your processes involving gases. See if the constituent you want to measure or use for automatic control is related to specific gravity. If it is, this simple, rugged instrument may save you a lot of money in original costs, installation and maintenance.

• Here are examples: In refineries: Ranarex measures hydrogen in recycle gas, cutting high maintenance costs and providing quicker response than costly, delicate analyzers formerly used. In chemical plants: Ranarex smoothly controls the blending of amine gases that could not be measured except by slow, high-cost laboratory-analysis methods. In oil and gas fields: Test cars

now average 18 gas-gravity readings per day with Ranarex instead of 8 with manually-operated, pressure-balance gravitometers.

• Other uses: In boiler rooms: Measuring CO₂ in flue gas, to determine proper air-fuel ratio, cuts fuel costs 5 to 20%. In heat-treating plants: Detecting improper furnace atmospheres to protect metal surfaces . . . detecting generator flame failure or dangerous atmospheres to prevent explosions. In gas utilities: Ranarex is used in manufacture, mixing and metering of fuel gas, In automotive servicing: For analyzing exhaust gases to improve engine efficiency.

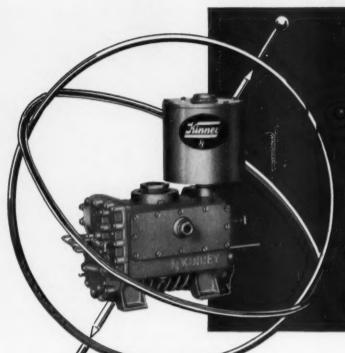
Indicates, records, controls. Operates valves, alarms, safety circuits, etc. through a pneumatic transmitter and controller or electric contactors.

Measuring gas specific gravity with Ranarex may simplify your process. We'll be glad to help you look into the possibilities. Ranarex Division, Dept. CE-9, The Permutit Company, 330 West 42nd St., New York 36, N. Y.

RANAREX°

DIVISION

THE PERMUTIT COMPANY



NEW Kinney

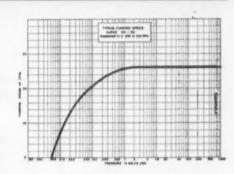
MODEL KD-30 HIGH VACUUM PUMP IS FUNCTIONALLY VIBRATION-FREE!

This Means...

- A pump ideally suited for portable installations or for systems requiring a minimum vibration tolerance factor
- Increased wear-life of pump components

This new, compact Model KD-30 pump of single stage-duplex design results from the continuing research and design experience that has made the Kinney vacuum pump line the world's largest. The "dynamically balanced" feature is vital in countless experimental, pilot plant, and production applications . . . and is augmented by other Kinney improvements, the Kinney Swirl Separator Tank, Gas Ballasting, etc. Check the specification data and pumping speed curve to see why Kinney is proud of this latest addition to its performance-proved line.

Our engineers will gladly send recommendations on your particular vacuum equipment needs. Request additional data today or contact one of our competently staffed district offices ... in Baltimore, Charleston, W. Va., Charlotte, N. C., Chicago (La Grange), Cleveland, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis . . . or The International Sales Office, 90 West St., New York 6, N. Y.



SPECIFICATION DATA

Model KD-30 Single Stage-Duplex Design High Vacuum Pump

Ultimate Press	U70	(Mc	le	ed	Ge	wge	e)			10 Microns
Free Air Displo	cen	nent			0					. 30.4 CFM
Free Air Displo	cen	tner			8				14.4	Liters/sec.
RPM			5				*			525
Motor H.P								2		11/2
Motor RPM										1800
Oil Capacity .										
Cooling										
Shaft Diameter										
Inlet Connectio										" screwed
Outlet Connect										" screwed
Valve Type .										Poppel
Separator Tani										nney Swirl
Net Weight, C										000 41

Overall Dimensions, Complete Unit with Motor Length - 283/4"; Width - 201/6"; Heigth - 197/6"

vrite

KINNEY MEG. DIVISION THE NEW YORK AIR BRAKE COMPANY

3551 WASHINGTON STREET . BOSTON 30 . MASS.

• Please send complete data describing the new Model KD-30 high vacuum pump.

Name

Company

Street.

City.

State

Title

CHEMICAL ENGINEERING—September 1956

STANDARD GEARING that meets SPECIAL needs available from

Foote Bros. has pre-engineered an extremely broad range of gears to form an almost complete variety of ratios, capacities, center-distances and sizes to meet specific requirements.

Manufactured to strictest quality standards, you'll find Foote Bros. open gearing the solution to availability and cost problems. See Foote Bros. for all your gearing needs. And they're completely cataloged...

FOOTE BROS. Duti-Rated Litetime Gearing

Here's greater capacity in less spacel Longer life Duti-Rated gears are specially heat-treated for increased tooth surface hardness and produced to high precision tolerances... yet can be ordered from stock to meet special gearing specificational Send for the Duti-Rated manual for complete information and technical data on the standardized styles and sizes available... ask for Manual DR-2.



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FOOTE BROS. GEAR AND MACHINE CORPORATION

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FOOTE BROS.
Worm Gear Sets
Standardization and Quantity produc-

Standardization and Quantity production—by Foote Bros.—make this line of quality standard and special worm geor sets possible. These are the same worm gear sets used in foote Bros. famous Hygrade Drives, now made available for special aperating and service conditions. Write today for this complete catalog of ratings and dimensional duta. Ask for Manual SW-1.





MIDWEST "LONG TANGENT" ELBOWS COST NO MORE THAN OTHER ELBOWS THESE MIDWEST "LONG TANGENT" ELBOWS SAVED \$4121 IN PIPE

Here are 1227 Midwest "Long Tangent" Elbows (12", 14" and 16" standard weight) ready for shipment to a chemical plant. Each Midwest "Long Tangent" Elbow has a straight section on each end equal in length to ½ the nominal pipe size. Thus a 12" elbow saves 6" of 12" pipe while a 16" elbow saves 8" of 16" pipe. It doesn't take long to save a lot of pipe and a lot of money . . . in this instance \$4121.

But saving pipe is not the only advantage of Midwest "Long Tangent" Elbows. They often eliminate short nipples and their extra welds... save time and money in lining up and clamping pipe and fittings... slip-on flanges are more easily applied. For all the facts, write for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo. Plants: St. Louis, Clifton, N. J. and Los Angeles

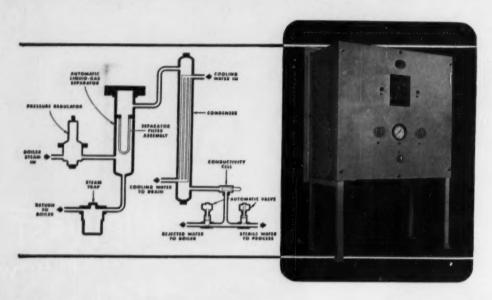
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MIDWEST WELDING FITTINGS

MIDWEST WELDING FITTINGS Improve Piping Design and Reduce Costs

STERILE, PYROGEN-FREE WATER FROM BOILER STEAM with Selas Steril-Aqua® System



New direct method produces up to 500 gallons per hour automatically, economically

Water—pure enough for injectable purposes—in quantities ample for even large industrial use... is produced directly from ordinary boiler steam by the Selas Steril-Aqua System.

The steam system in your plant provides not only the heat source but the actual raw material to be converted by the Steril-Aqua System into sterile, pyrogen-free water containing less than one part per million total solids.

Hospital, bacteriological and pharmaceu-

tical laboratories are replacing conventional water-still methods with Selas Steril-Aqua Systems . . . thereby saving time, maintenance and fuel costs.

And now, chemical laboratories and industrial processing operations—where water of exceptional quality is desirable—may have the benefits of Selas Steril-Aqua Systems. Manual or completely automatic, standard units are available in capacities up to 500 gallons per hour. Larger units will be built to your requirements.

Write for descriptive literature and explain your specific needs. Address Dept. 116.



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DEVELOPMENT . DESIGN . CONSTRUCTION



INTERESTING FACTS ON VALVE PERFORMANCE (from a case history in Crane's files)

7 years' trouble-free service on HCL acid with this Crane diaphragm valve

How do Crane diaphragm valves perform on acid services?

This major container manufacturer has impressive proof. Seven years ago, the Crane 4-inch No. 1615-RN rubber-lined diaphragm valve shown above was installed on 17 deg. Baume hydrochloric acid service. The acid is used to clean evaporators and surface condensers. Not once has this Crane diaphragm valve failed to function—not once has it failed to hold tight.

Previously, this plant used conventional all-metal valves. These had to be replaced regularly as an expendable material. The Crane valve has eliminated all replacement costs by providing maintenance-free performance—and from all appearances will continue to do so for years to come.

You just don't get service like this from ordinary valves. Crane valves are so expertly designed, have such quality materials and are so carefully machined and tested that cost-free records like this are the rule rather than the exception with Crane users.

Get the facts on Crane diaphragm valves from your local Crane Representative, or write to address below.



CRANE VALVES & FITTINGS

These Valves Made for You
— See Other Side

Since 1855—Crane Co., General Offices: Chicago 5, III. Branches and Wholesalers Serving All Areas

For a wide range of control and stop services

CRANE Packless Diaphragm Valves

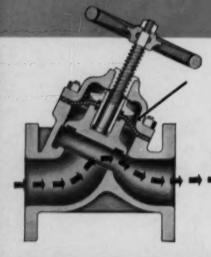
Broad selection of body, diaphragm, and lining materials

Y-Pattern body—designed to reduce pressure drop and assure accurate flow control with minimum resistence.

Sizes: 1/2 to 2 inches with Screwed Ends; 1/2 to 14 inches with

Working Pressures: (Weter, Oil, Air er Ges)-50 to 150

Crane Packless Diaphragm Valves are designed to solve one of industry's major problems—the leakage of costly, dangerous fluids or gases. Crane skill and experience in design, construction and assembly are evident in every feature of these valves. To your manufacturing processes, this means foolproof, trouble-free control over years and years of service-important to your product quality, important to your cost sheets.



Separate Seating Assures Positive Shutoff

Diaphragm functions for bonnet-sealing, and is not subjected to crushing or excessive wear. Seating is done by separate, circular flat-face disc, connected to stem and joined to diaphragm with special leakproof connection. Pliable insert recessed in face of disc closes tightly against integral body seat, providing exclusive Separate-Seating feature which assures positive shutoff without loss of materials-even if diaphragm should fail. Separate-Seating also permits operation under pressure or vacuum with minimum torque and fewer turns.

Crane Unlined Packless Diaphragm Valves

For General and Corresive Services



Flanged or Screwed Ends. Body: Brass, Cast Iron, Alu-Keli F or Natural Rubber.

Available with Motor

For Corrosive Process Fluids, Sludges and Slurries

Crane Lined Packless

Flanged Ends Only. Cast Iron Body. Neoprene or Hard Natural Rubber

Diaphragm Valves

Maximum Temperatures up to 180° F.

Available with Motor

Sliding Stem Crane Diaphragm Valves

Available lined or unlined, these valves are identical to wheel-operated valves above except for upper end of valve bonnet, which has flange with machined face and inner-threaded opening. Suited for manual, automatic or positioned control operation. Almost any make of hydraulic or pneumatic actuator can be readily applied to these valves.

Ask for this booklet

This Crane Diaphragm Valve booklet gives you 24 pages of detailed, illustrated information-including features, CV flow factors and stem thrust charts, suggested applications, selection aids, and on-the-job applications. Ask your Crane Representative for Circular AD1942, or write Crane Co., Chicago 5, Ill.

RESIN DHESIVES **EMULSIO** PAINTS COATINGS you could fill volumes about products that benefit from Vinyl Monomers

Today, more and more industries are finding out that by starting with a Vinyl Monomer, they end up with an improved product.

Stronger adhesives and binders for non-woven fabrics. Water and grease resistant coatings for paper, leather and cloth. Vehicles for scrubbable water-base paints. Efficient emulsifying agents, textile sizes and specialty adhesives. Tough, transparent films, protective coatings and safety glass interlays.

Every one of these product improvements can be chalked up to the unusual properties and advantages gained through the use of Vinyl Monomers.

Three Vinyl Monomers - Celanese currently supplies industry with three basic vinyl monomers: Vinyl Acetate...Vinyl Propionate...and Methyl Isopropenyl Ketone. This versatile Celanese trio is already providing a rich source of product improvements and production economies. Additional Celanese monomers are under development. Perhaps we can help you make your product better. Celanese Corporation of America. Chemical Division, Dept. 553-I, 80 Madison Avenue, New York 16.

Basic reasons.

Functional Fluids Acids Gosoline Additives Aldehyde Glycals Anhydrides

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Polyols **Plasticizors** Saits

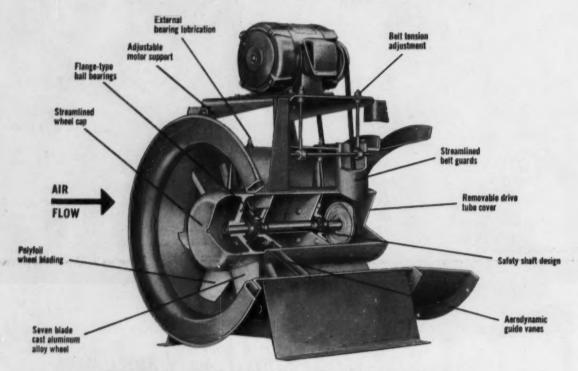


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EW | Improved | Westinghouse Axial Flow Fans

for Industrial air, fume, vapor handling jobs!



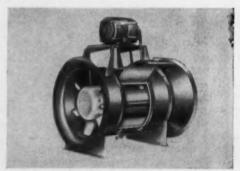
CUTAWAY VIEW OF WESTINGHOUSE AXIFLO® VANEAXIAL FAN FOR GENERAL APPLICATION.

COMPLETE NEW LINE

With: volumes from 1,700 to 100,000 CFM—static pressures up to 3½"—14 sizes, Vaneaxial or Tube Axial, direct-connected or V-belt driven, with wheel diameters from 15" to 72".

- Space Saving . . . compact Axial Flow design permits installation directly into duct work.
- Improved performance... non-overloading horsepower feature permits use of smaller motors.
- Least maintenance . . . rugged practical construction insures continuous trouble-free operation.

For complete application service, call your nearest Sturtevant Sales Engineer, or write Westinghouse Electric Corporation, Sturtevant Division, Dept. 13J, Hyde Park, Boston 36, Mass.



Spray booth Vaneaxial Fan specially designed to provide easy access required for paint spray exhaust!

WATCH WESTINGHOUSE!

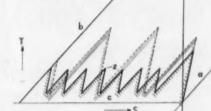
COVER PRESIDENTIAL CAMPAIGNS ON CBS TELEVISION AND RADIO

September 1956—CHEMICAL ENGINEERING

it works on paper...

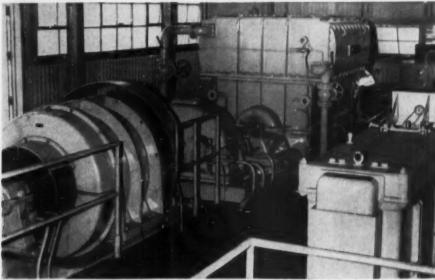
THE Brown Boveri Isotherm Compressor compresses the air along the solid line (Z) in nine stages with seven intermediate coolers. This arrangement justifies the name of "Isotherm" because compression approaches the ideal isothermal line. The broken line indicates the compression characteristic when only three intermediate coolers are used. The difference between the areas below the compression lines is a measure of the difference in required power input.

Compression Characteristics of Brown Boveri Isotherm Compressor



- a—Initial Pressure
- b-Delivery pressure
- c-Isothermal
- S-Entropy
- T-Absolute temperature

it works on the job ...



THE 18,000 SCFM
Brown Boveri Isotherm
Compressor in the new
Nitric Acid Plant of the
Mississippi Chemical
Corporation at Yazoo
City, Miss. This plant
was designed and constructed by Chemical
and Industrial Corporation.

A BROWN BOVERI Isotherm Compressor unit makes possible major economies in any kind of chemical processing where large volumes of air at modest pressures is required.

Each unit is completely integrated equipment consisting of the inter-stage cooled isotherm compressor, a reaction-type highly efficient expander and a synchronous motor.. all designed, manufactured and tested by Brown Boveri to operate as a "package" unit. Its design embodies more than a quarter century's experience in producing large air volume compressors for a wide variety of purposes plus a world-wide reputation for leadership in gas turbines and electrical power generating and distribution equipment.

Users of Brown Boveri Isotherm Compressors are assured of greater efficiencies, substantial dollar savings in operational costs, longer life, dependable and trouble-free operation and far less maintenance than with any comparable equipment on the market today!



BROWN BOVERI CORPORATION

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We've done one thing for you. Chapman's Motor Units . . . for operation of valves, floorstands and sluice gates . . . are in the best of condition for accurate performance and longer, lower cost life.

We've made them as you like them ... simplified them ... streamlined them ... taken off all the fat. In fact, when you look at a Chapman Motor Unit today, you can only find approximately half as many parts as on any other unit.

This simplicity, combined with Chapman's traditional ruggedness, means less trouble and lower maintenance over a longer period of smooth, accurate performance.

How can you go wrong? With Chapman Motor Units, the simplified design . . . the sturdy construction... mean no drift; less slash, accurate micrometer-controlled limit switch for predetermined seat tightness; quiet motor driven operation at all times. All at the lowest overall cost.

No trouble with operating positions. Operation is assured at any angle. Rugged stub-tooth gears need no grease or oil. No trouble with operating conditions. All units are weatherproof . . . steam tight. No trouble even with installations. When used with floorstands they are completely wired at the factory . . . ready to connect with your leads. Easy and simple to install.

Get our new catalog . . . Catalog 51 . . . on Chapman motor units today.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS



DRYING RANGES

highest product uniformity!



PRODUCT UNIFORMITY is of utmost importance to every food processor, at all stages of processing. The Proctor continuous conveyor dryer installation shown above is located in a plant of one of the world's largest food manufacturers—typical of many in use in the food industry today. In this plant Proctor Dryers assure uniformity of color, taste, and high customer appeal—yields are greatly increased!

WITH UNIFORMITY COMES PROFIT. Efficient drying per pound of product can often mean more direct profit than an increased sales volume. Proctor equipment provides the control, flexibility and construction features essential to profitable drying performance. Write or phone today for complete information.

GUARANTEED QUALITY OF PRODUCT

FLEXIBILITY

PROFITABLE OPERATION

OTHER PROCTOR DRYING EQUIPMENT FOR THE FOOD AND PROCESS INDUSTRIES

TRAY DRYERS • TRUCK DRYERS
PRE-FORMING FEEDS • SPRAY DRYERS

PROCTOR & SCHWARTZ, INC.

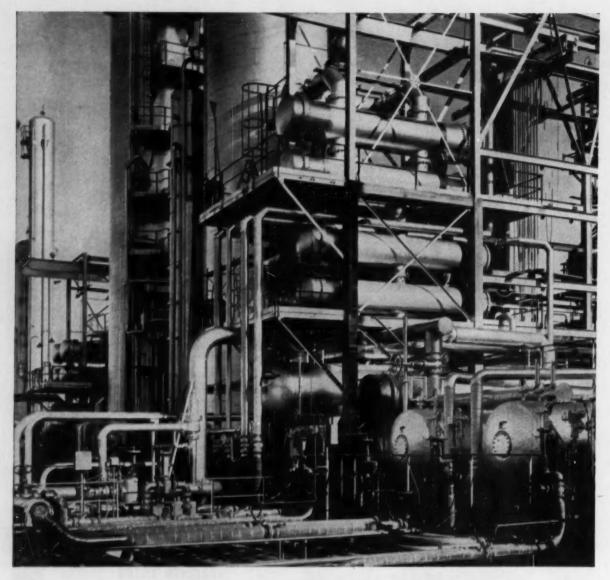
Philadelphia 20, Pa.



MANUFACTURERS OF INDUSTRIAL DRYING EQUIPMENT AND TEXTILE MACHINERY

CHEMICAL ENGINEERING—September 1956

339



When temperatures and thruput go **UP...**Turpenter Stainless Tubing holds corrosion costs **DOWN**

• Is the thread of rapid deterioration of tubing in heat exchangers and other process units keeping you from raising temperatures and increasing velocities?

Carpenter Stainless Tubing and Pipe have proven their ability to stand up under increased temperatures and thruput, with substantial cost reductions in material, labor and downtime.

Complete line of 14 standard AISI analyses and many other special alloy grades are available. Write for latest Selecting and Buying Guide... or contact your Carpenter Distributor now.

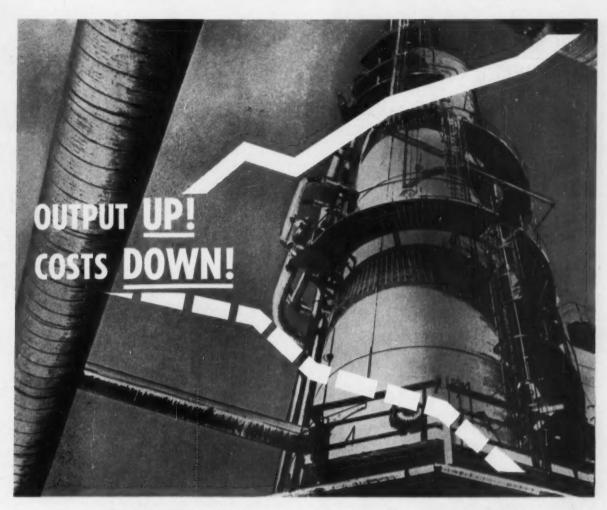


The Carpenter Steel Company Alloy Tube Division, Union, N. J.

Expert Dept.: The Carpenter Steel Co., Port Washington, N.Y .- "CARSTEELCO"



Stainless Tubing & Pipe



with METEX Hi-Thruput MIST ELIMINATORS

METEX Hi-Thruput Mist Eliminators, installed in process towers and vessels, effect sharp separation of liquids and gases. Quality and yield are increased. Valuable liquids are knocked out and returned. Contamination of subsequent processing is removed. Turbines and compressors are protected from damaging liquids. Where build-up of coke or solids is a consideration, on-stream service life is increased three to four times. Air pollution is reduced, too.

METEX Hi-Thruput Mist Eliminators provide virtually 100% removal efficiency, even at extreme temperatures and pressures. Pressure drop is negligible. Their outstanding performance is due to re-

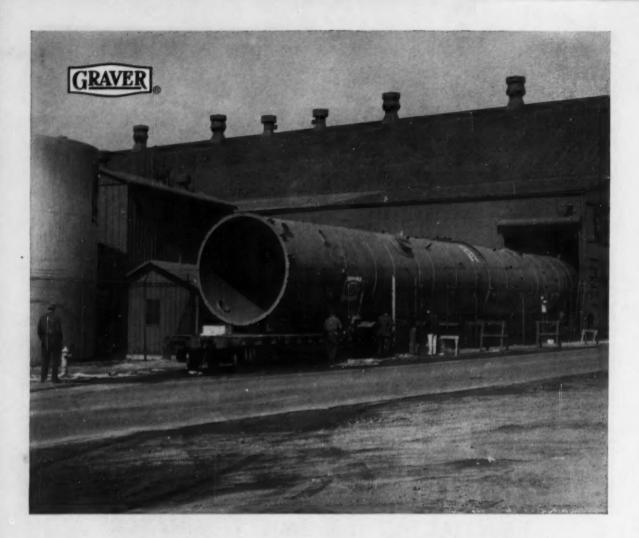
positioning of the wires by the METEX patented Herringbone Fold... an exclusive development of the originators of knitted wire mesh entrainment separators. Impingement target area is increased and stagnation points reduced.

In any processing equipment or vessels where liquid entrainment is a contributing factor in design or operation, specify METEX Hi-Thruput Mist Eliminators to assure greater production, improved quality of yield and substantially reduced operating and maintenance costs.

For complete information and specifications, write today for your free copy of Bulletin No. ME-6.

METAL TEXTILE CORPORATION ROSELLE, NEW JERSEY

Matel Textile Corp. of Canada, Ltd., Hamilton, Ostario & Representatives in principal cities throughout the world



A Fractionator tower for the West

It's nosing out of the Graver plant at East Chicago—all 93 feet of it—on its circuitously routed journey to a western refinery.

Graver will design and build your complex process fabrications of carbon steel or alloy—stainless, stainless-clad, nickel-clad, Monel, Hastelloy or aluminum. Graver quality is assured by every modern technique for manual and automatic welding, stress relieving, heat treating, X-raying and other methods of inspection.

For the very best in custom-built process equipment and its installation, call on the experience of Graver.

GRAVER TANK & MFG. CO., INC.

East Chicago, Indiana

CHICAGO • NEW YORK • PHILADELPHIA • EDGE MOOR, DEL. • PITTSBURGH • DETROIT • TULSA
SAND SPRINGS, OKLA. • HOUSTON • LOS ANGELES • FONTANA, CAL. • SAN FRANCISCO

GRAVER

Autoclaves
Digesters
Elevated
water tanks
Oil field
equipment
Pressure
vessels
Storage tanks
Towers V
Weldments

where **POWER** is **VITAL**

ASCO AUTOMATIC TRANSFER SWITCHES help assure round-the-clock communications for **Bell Telephone System**

Each day millions of voices and scores of television and radio programs are flashed through some 50,000 miles of Bell System radio relay channels. Transmission through this vital chain of communications must be constant to meet the needs of a growing and busy America. That's why the Bell System has engineered complete safety and emergency features into many of its unmanned and often isolated radio relay stations.

Typical of these safety precautions are ASCO Transfer Switches which in case of failure of local power supply automatically transfer the load to an emergency power source.

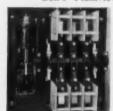
Dependable Control by ASCO

Where power and dependability are vital, ASCO switches give these signal design advantages: • continuous duty rating in either normal or emergency position · capacity to withstand inrush currents 20 times full load rating · mechanical locking, providing high contact pressure · single coil design · built in time delay, so that equipment ignores harmless momentary outages · full phase protection, and other design features.

For these reasons, many engineers today specify ASCO - the one source for a full line of dependable automatic transfer switches. Write for Publication 596 describing how to select an adequate automatic transfer switch.

Dependable Emergency Power

Here is the ASCO Transfer Switch installed at Bell's Plainview, L. I., radio relay station.

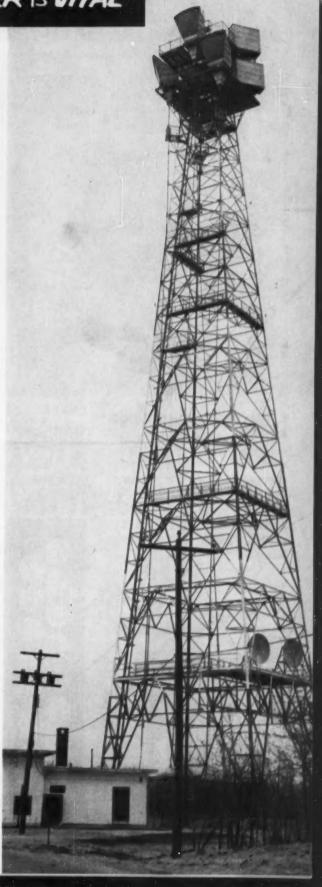


ASCO Automatic Transfer Switch - Bulletin 905. When normal power fails, this Switch transfers the load to the emergency source; the Switch will retransfer the load when normal is again in proper operating condition. Accessories permit delayed transfer to emergency and retransfer to normal in order to attain system stabilization before the selected source assumes the load.

Important announcement . . . new ASCO plant now being built in Florham Park, N. J., will double production capacity and greatly extend the range of our research, product development and services.

Automatic Switch Co.





Yours FREE!

TECHNICAL LITERATURE

- 1. VALVE TECHNICAL DATA...

 Twelve page technical manual giving design, selection, maintenance and repair data for stainess steel valves.
- 2. GETTING THE MOST OUT OF YOUR VALVES... Four page technical discussion explaining selection, installation, inspection and maintenance of stainless steel valves.
- 3. CATALOG 55D (VALVES)...

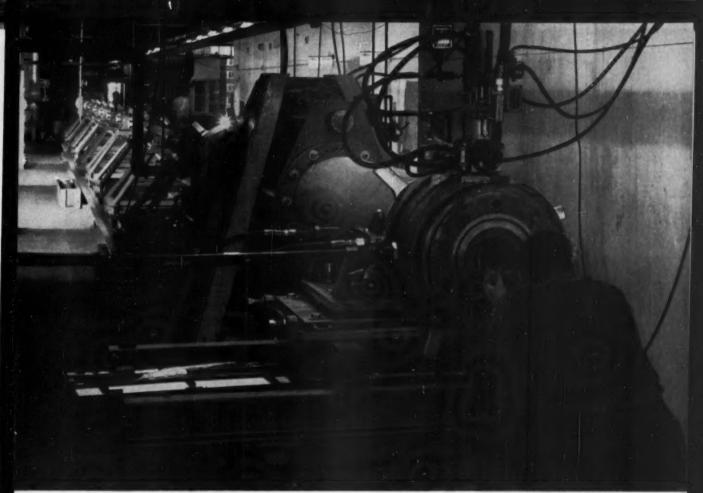
 Sixty-eight page simplified stainless steel valve catalog includes engineering drawings, weights, size ranges, dimensions and basic material duta.
- 4. CATALOG 55F (FITTINGS)..

 Complete stainless steel fitting catalog giving engineering drawings, dimensions and basic material data.
- 5. VALVES TO COMBAT COR-ROSION . . . 75 questions and answers selected from Cooper Alloy valve clinics covering materials, operations, service problems, installation and repair.
- 6. STAINLESS STEEL VALVES AND FITTINGS IN THE PAPER INDUSTRY... Eight page technical article covering alloys, valve selection, design factors, installation, maintenance, operation and inspection of stainless steel valves and fittings used by the paper industry.
- 7. PLASTIC PUMPS... Four page folder describing the Vanton "Flex-i-Liner" pump. Full and cut-a-way views, plus performance charts and material selection hints are included.

- 8. PLASTIC PIPE AND FITTINGS
 . . . 8 page catalog on Vanton P-Line (PVC), N-Line (Buna N) and S-Line (Styrene) pipe, valves and fittings.
- PUMPING CORROSIVES ...
 Four page article describing the transfer of hydrochloric, formic, lactic acid and salt solutions at Litho Chemical.
- 10. ADVANCED KNOW-HOW...
 Series of case studies showing how advanced know-how made possible the economical production of high alloy products considered difficult or impossible to cast.
- 11. MATERIALS SELECTION
 CHART... Four page chart designed to assist in the selection of the most economical alloy for a given corrosive problem. More than 350 specific corrosives are included.

- 12. DESIGN CONFERENCE . . . Special edition of Newcast containing the technical papers presented at the Cooper Alloy Design Conferences. Subjects incude Casting Design, Shell Molding, Cast Weld and New Materials.
- 13. ALLOY REFERENCE CHART
 ... Revised four page pamphlet listing alloy designations, applications,
 properties and analysis of corrosion
 and heat resisting alloys.
- 14. STAINLESS STEEL CAST-INGS ON PARADE... Four page folder presenting a variety of cast parts with information as to alloy, weight, application. Complete data chart listing twenty-eight alloys with recommendations for their use is included.
- 15. NEWSCAST... An eight page bi-monthly publication devoted to reporting technical material of value to those interested in corrosion resistant castings, fittings, valves and pumps.

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A technician checks the ALCOPLATED interior of the giant shock tube's driver section.

ALCOPLATED DRIVER SIMULATES 18,000 MPH, 15,000 F

Chemically Deposited Nickel Plate Serves Under Extremely High Temperatures and Pressures; Corrosion and Erosion Resistance Help Avco Researchers Reach Some of the Highest Speeds Ever Attained.

Inside the world's largest hypersonic shock tube, a gas dynamics research device developed by Avco Manufacturing Corporation for the U. S. Air Force, speeds to 18,000 mph and split-second temperatures as high as 15,000 F are reached. Pressurized gases, built up in the tube's driver section, burst a metal plate to form a shock wave simulating travel at 25 times the speed of sound.

Using Alcoplate in the internal bore of the driver section gives Avco Research and Advanced Development Engineers the corrosion resistance and hardness qualities necessary to withstand tremendous internal pressures. In the driver, as in all cases, Alco's quality controlled application of Alcoplate meets the highest customer requirements and produces uniform, adhesive plating.

Chemically deposited nickel-phosphorus Alcoplate, providing protection from erosion and corrosion in this unusual application, can mean savings and process equipment protection in normal industrial applications, too. Inquire at the nearest Alco Sales Office or write to P. O. Box 1065, Schenectady 1, New York for further information.

*ALCOPLATE — Trade-mark registration applied for. An application of "Kanigen" a mark identifying the chemical deposition of high-nickel, low-phosphorus alloy by General American Transportation Corporation and its licensees and the coating resulting therefrom — on license from General American Transportation Corporation.

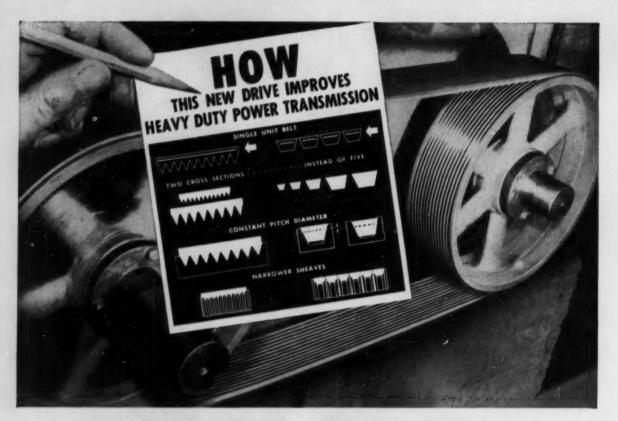


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Locomotives · Diesel Engines · Nuclear Reactors · Heat Exchangers · Springs · Steel Pipe · Forgings · Weldments · Oil-Field Equipment



R/M Poly-V® Drive Delivers More Power in Less Space!

No other belt drive can deliver as much power in the same space. It's R/M's patented Poly-V Drive developed by R/M engineers after years of research. This totally new concept in power transmission delivers up to 50% more power than a conventional V-belt drive of equal width.

Unique design accounts for the unusual power capacity of R/M Poly-V Drive. A single, endless belt with parallel V-ribs runs on sheaves specially designed to mate precisely with the belt ribs. The uniform pull of this single unit belt distributes drive load evenly over the full width of the sheave... gives higher horsepower capacity per inch of drive width than ever before possible.

There are many advantages in this space-saving drive wherever heavy duty power transmission is required . . . in the equipment you manufacture—or the equipment you use in your plant. Poly-V Drive has eliminated the matching problems of multiple V-belt drives,

greatly increased the life expectancy of belts and sheaves and maintains more constant speed ratios under all loads. Just two cross sections of Poly-V meet every heavy duty power requirement—R/M Poly-V Drive cuts costly belt and sheave inventories to a new low!

Let the R/M engineers who developed Poly-V Drive work with your engineers to improve your power transmission applications. Contact R/M... or write for a copy of Poly-V* Drive Bulletin #6638.

CONDOR V-BELTS . R/M SUPER-POWER V-BELTS

Write for Bulletin #6868 on the complete line of Condor V-Belts for regular service on conventional V-belt drives. Also write for Bulletin #6628 on R/M Super-Power V-Belts with 40% more Horsepower capacity where needed.



*Poly-V is a registered Raybestos-Manhattan trademark

RM 648



MANHATTAN RUBBER DIVISION - PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.















Flat Betts V-

Conveyor Bell

Hose

Roll Covering

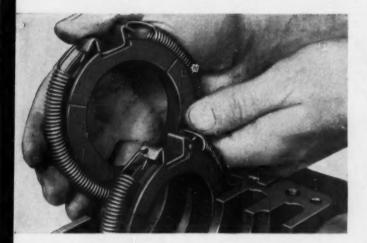
Tank Lining

Abrasive Whee

Other R/M products include: Industrial Rubber * Fan Belts * Radiator Hose * Brake Linings * Brake Blocks * Clutch Facings Asbestos Textiles * Packings * Engineered Plestic, and Sintered Metal Products * Laundry Pads and Covers * Bowling Balls

On all General Electric High-speed Turbines,

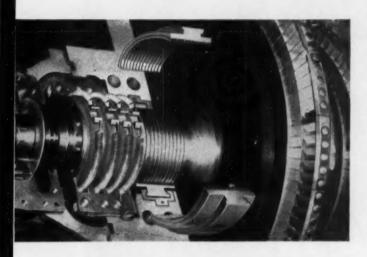
Well-designed, efficient seals...



Highly efficient, easily-replaced carbon packings

For the most effective shaft-end sealing, well-designed, low-cost carbon packings are used on G-E High-speed Turbines to seal steam pressures up to 75 psig. Made of non-galling, self-lubricating carbon-graphite, these segmental rings have high mechanical strength in the small sizes used, assuring long life under normal operating conditions. A garter spring in an offset "V" groove holds each ring together and presses it firmly against the side of the chamber, forming a tight seal. This unique arrangement permits the rings to support their own weight and to adjust themselves to the shaft position, thereby reducing wear and increasing the life of the seal. The rings are contained in compact external packing boxes, and can be easily inspected or replaced without breaking the horizontal joint of the wheel casing.

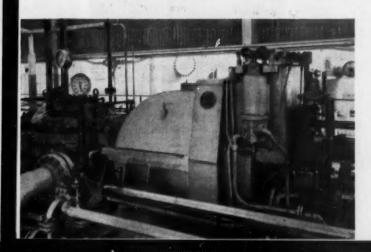
cut steam leakage...



Reliable, long-life metallic-labyrinth seals

To effectively minimize shaft-end steam leakage where shell pressures exceed 75 psig, segmental, high-low tooth metallic-labyrinth seals are used in combination with carbon packing. Between stages, straight-tooth metallic-labyrinth seals are always used. For maximum seal efficiency, minimum clearances between the teeth and the shaft are maintained by precision-machined hook fits in the packing housing. Shaft scoring is practically eliminated since the leaded-bronze segments are spring-backed and can move outward should there be accidental contact with the shaft. When unbalanced steam pressure forces axial movement of the seals, the shoulders of the rings and the housing engage to form a tight steam seal. All labyrinth seals are designed to compensate for thermal expansion, thus assuring a most efficient steam seal at operating temperatures.

reduce maintenance costs



The careful design and manufacture of these steam seals is your further assurance of low maintenance and consistent reliability of G-E High-speed Turbines. Why not check into the many other sound design features built into these mechanical drives? Your Apparatus Sales Representative will be glad to explain the many benefits they offer to your operation. Contact him for further information or write for Bulletin GEA-6232, General Electric Company, Section 241-7, Schenectady, N. Y.

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Editor in the Air...



with both feet on the ground!

Just keeping up with Sid Kirkpatrick would have anyone on the fly. For Sid—"if anyone calls me Sidney, it's my cue to duck"—is something more than Editorial Director of two of McGraw-Hill's most dynamic magazines. A long-time member of the "have tux will travel" school, he is a familiar and respected figure in chemical plants and their front offices throughout the United States.

From his unique vantage point, Sid is able to maintain a constant bird's-eye view of the editorial direction of CHEMICAL ENGINEERING and CHEMICAL WEEK, and of the giant chemical process industries they serve. It is this same broad view that enables him to look at both sides of every significant story. He works closely with the editor of CHEMICAL WEEK, who interprets the important business news for management menand the editor of CHEMICAL ENGINEERING, who reverses the field to give engineering knowhow and economics to technical men. In between, Sid, who is also a Vice President of the McGraw-Hill Book Company, has sandwiched almost 30 years' service as Consulting Editor for its Chemical Engineering Series of texts and reference books. Of them he says, "We built a profession by building a permanent foundation of literature beneath it."

Sid has piled up an impressive list of other achievements, too. He "picked enemy brains" behind the German lines before V-E Day as a member of the Technical Industrial Intelligence Corps. Later, he served with the National Commission on the Disarmament of Japan. This was history repeating itself, for Sid was associated with the American Commission to Negotiate Peace at Versailles after World War I, where he helped draft the technical portions of the treaty dealing with coal tar chemicals and dyes. (In his

typical self-effacing manner, Sid says he was just an errand-runner for Bernard Baruch.)

Today, Sid still serves the government. He is Chairman of the Advisory Committee on Industrial Information, U. S. Atomic Energy Commission. As a consultant to the Army Chemical Corps, he was also a member of the accredited scientific observer staff at Bikini for "Operation Crossroads".

Some of the other highlights coloring Sid's career include Member, Director and Past President of both American Institute of Chemical Engineers and the Electrochemical Society. In 1952, the American Institute of Chemists summed up Sid's many activities when he was made an Honorary Member. The citation read: "Sidney D. Kirkpatrick, outstanding editor, who by taking strong stands where needed for the good of the profession, promoting the Chemical Engineering Achievement Award, taking active leadership in professional societies, and encouraging younger men by speaking and guiding junior groups and individuals, has contributed to the profession . . . of chemical engineering far beyond the normal call of duty."

Experience like his is typical of many McGraw-Hill editors. Their detailed knowledge makes them specialists with feet-on-the-ground awareness—both literally and figuratively. They live with the problems of the men in the fields they serve and provide them with accurate reporting and helpful business information.

That is why their "product" can't help but be good. Consistent editorial quality is the reason more than a million men pay to read McGraw-Hill magazines. And it's the reason why McGraw-Hill magazines provide an alert, interested and responsive audience for advertisers' sales messages to business and industry.

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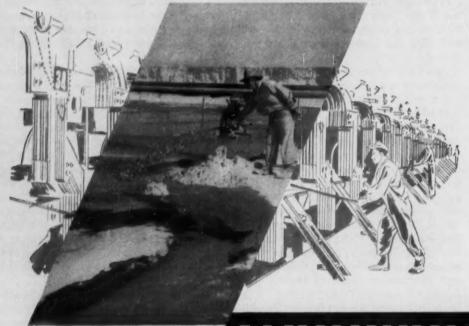


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ALUMINUM

Surely a 'headline product' even if not new! Aluminum is very much in the news today for it is playing a leading role in our steadily expanding economy.

What's all this got to do with Sulphur?

It's like a chain reaction. Demand for this remarkable light metal is increasing. This calls for more ore development and additional mills for the reduction of alumina to aluminum. More cryolite is needed for fluxing the molten alumina in the electrolytic cells.

True, cryolite (Na₃AlF₆) is found in nature but there just isn't enough tonnage to satisfy its many uses. So, to fill the supply gap, cryolite is being synthesized from fluorspar. It is here that Sulphur enters the picture, for one of its widely used derivatives — Sulphuric Acid — is a key reaction agent.



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When you use Rockwell-Nordstrom valves you get "extras" you can't buy in ordinary valves. Pressurized lubrication in the Sealdport* system assures leakproof sealing (without uncertain "forced" seating), and eliminates costly wearing friction. Because they are rotary plug valves, quarter-turn operation and unexposed seating are two more money saving extras. The cost? Rockwell-Nordstrom valves cost no more

to buy (often less) than ordinary valves and cost much less to use.

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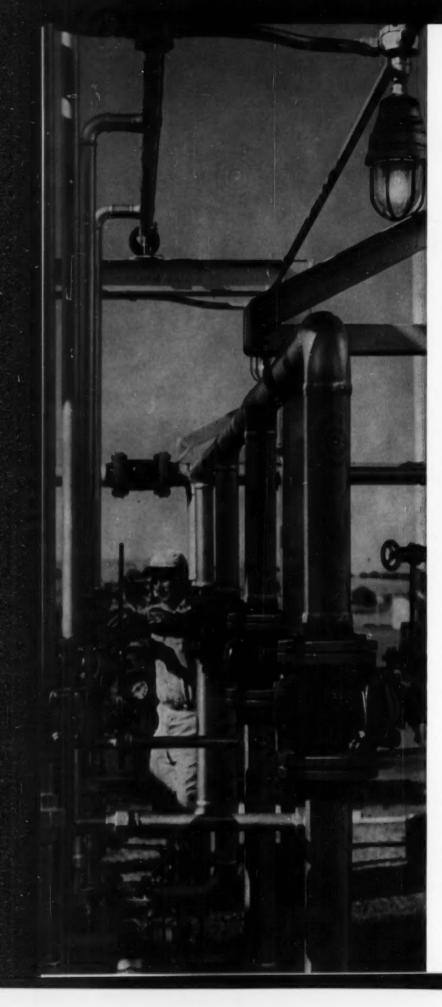
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ROCKWELL-Nordstrom VALVES

Lubricant Sealed for Positive Shut-off

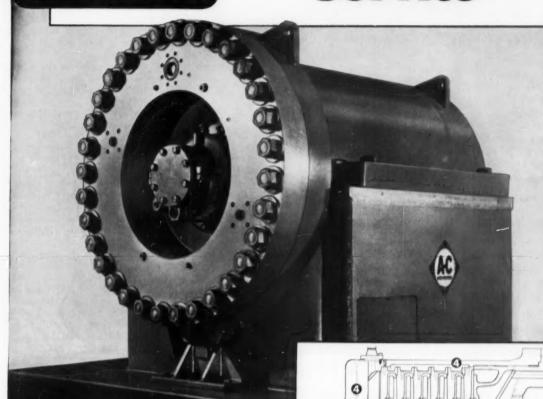


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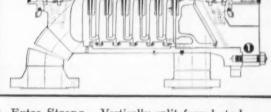
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High Pressure
Barrel-Type
COMPRESSORS

for <u>Non-Stop</u> Service



'Round-the-Calendar Operation is built into the complete line of Allis-Chalmers high pressure barrel-type units for reforming processes. Here are four reasons for their dependability:

- Simple to Maintain Only one head bolted. Spiral-wound metallic gasket provides positive seal of casing joint.
- 2. Shaft Sealing Double bushing seals have separate high pressure oil system. Inward seal leakage minimized.
- **3.** Rugged Rotor Impellers shrunk and keyed to shaft. Riveted impellers have rivets milled integrally from blade edge.



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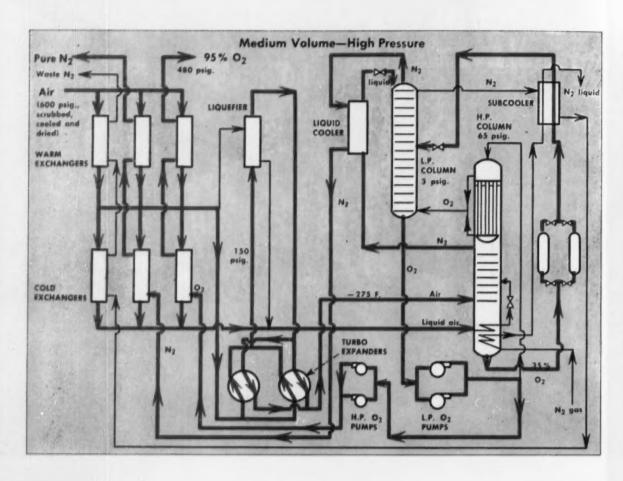
Find out more by contacting your nearby A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

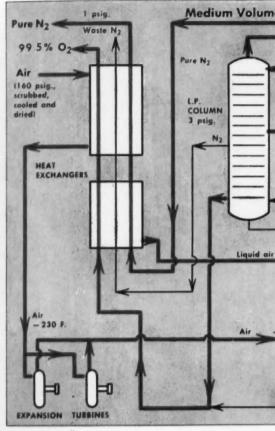


ALLIS-CHALMERS



...





10% caustic soda to remove carbon dioxíde, cooled in an ammonia chiller to 40 F. and dried.

It then enters the low temperature unit where it is further cooled in a group of parallel exchangers against the outgoing products pure nitrogen, waste nitrogen and high pressure oxygen.

After the warm exchanger, the air stream splits. Part goes to a expansion turbine. The remaining portion is partially liquefied in cold exchangers and after passing through a reboiler coil in the column pot, flashes to column pressure at a point a few trays up the column.

The first separation of air is carried out in the high pressure column at a pressure of 65 psig. into a bottoms product called "rich liquid" containing about 35% oxygen, and an overhead product of pure nitrogen. Bottoms are withdrawn and pass through a silica-gel filter to remove acetylene and hydrocarbons, subcooled against the waste nitrogen stream and flashed as feed to the low pressure column.

Gaseous nitrogen from the top tray of the high pressure column is condensed in the main reboiler against evaporating oxygen. Part provides reflux for the high pressure column and part is withdrawn and after subcooling against pure nitrogen product, provides reflux for the low pressure column.

Final separation into oxygen and nitrogen takes place in the low pressure column at a pressure of about 3 psig. The 95% liquid oxygen is removed from the bottom of the column by a high pressure centrifugal pump.

► High Purity—In a high purity nitrogen plant oxygen usually has only secondary importance (see flowsheet for 80 tons/day O_s unit).

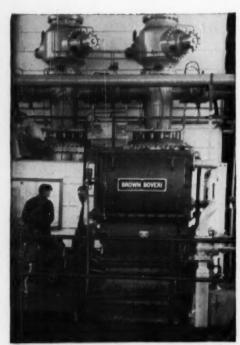
Air is compressed to a pressure of 160 psig., usually in a turbo blower if the air volume is sufficiently large (approximately 6,000 scfm.), scrubbed with caustic cooled to about 40 F. in an ammonia cooler, dried and admitted to the low temperature unit.

To get high purity nitrogen with high recovery, it's necessary to remove the argon from the low pressure column. This is done at a point about one-third up the column and forms a third outlet stream of argon, nitrogen and oxygen. In this manner, the oxygen product is usually 98.5 to 99.0% and the oxygen content in the nitrogen can be kept below 50 ppm.

► Other Designs—A need for tonnage, low pressure 95% oxygen calls for another process variation with reversible regenerators or exchangers (see flowsheet).

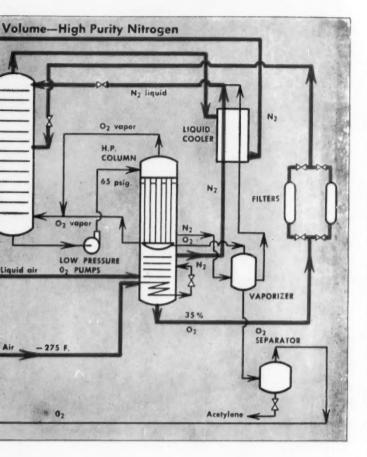
Hidalgo Chemical's Fisher-Tropsch plant at Brownsville, Tex., has such a unit with a design capacity of 50 million cu. ft. air/day. International Nickel has a 325 ton/day unit at Copper Cliff, Ont., for flash smelting operations. Cyanamid has a similar unit at an acetylene plant at Fortier, La.

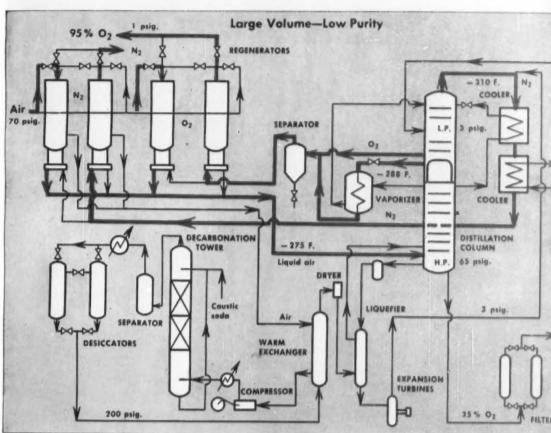
Typical requirements for a 300 ton/day oxygen plant (chemical purification): caustic soda—150 lb./ton O₂; ammonia refrigeration—8.7 Btu./ton O₂; power—375 kwh./ton O₂; manpower—2 operators/shift.

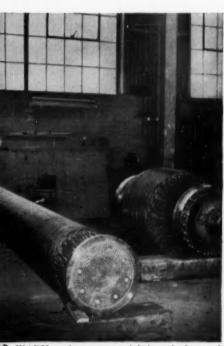


ROTARY compressors operate at low imput pressures. (Dominion Foundries)

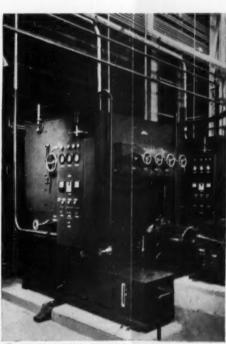
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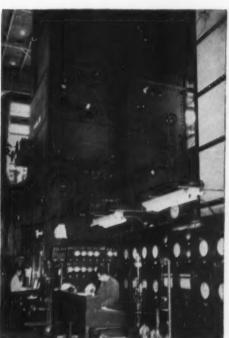




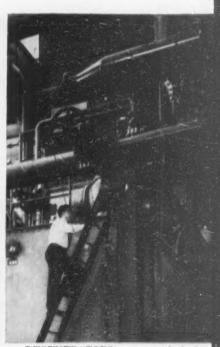
WARM exchangers are fabricated of wound copper tubing. (American Air Liquide)



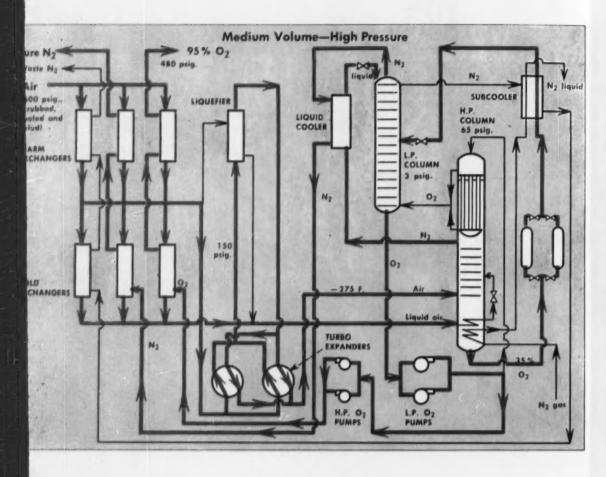
3 TURBO-EXPANDERS supply part of the air plant refrigeration. (McLouth Steel)

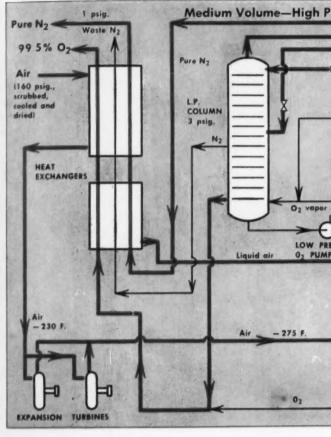


1 DISTILLATION columns, the heart of tonnage plants, operate around -275 F. (Linde)



REGENERATORS are practical for pressures and high imputs. (Linde)





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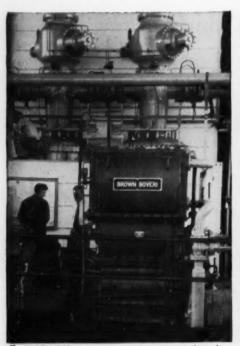
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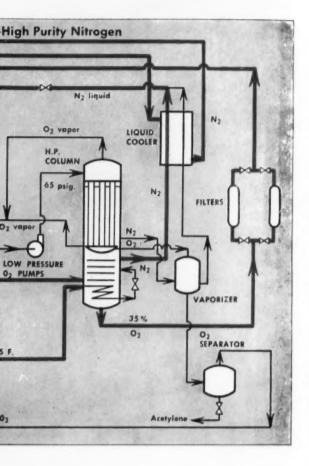
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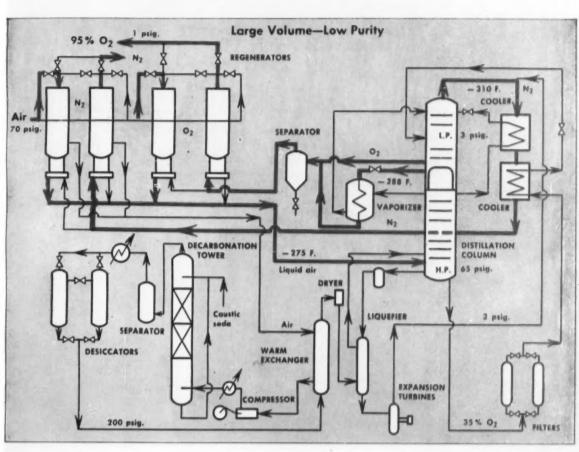


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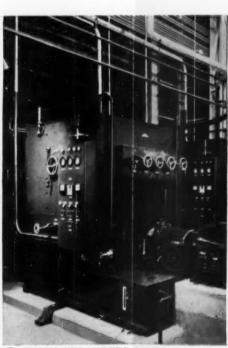
WARM exchang copper tubing.



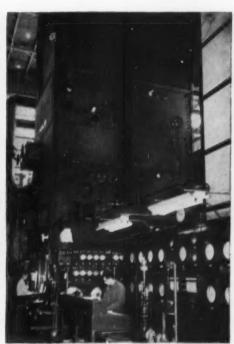




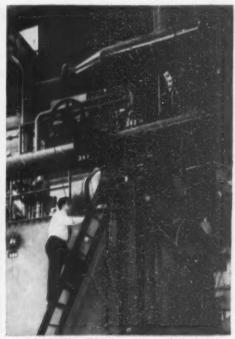
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AIR SEPARATION: you need distillation columns, condenser and separator.

Upsurge in Tonnage O2 Units

Volume production and improved technology have lowered costs — now O_2 and N_2 are important new raw materials.

During the last 10 years oxygen has changed from the category of a high-priced fine chemical to a lowpriced tonnage raw material.

Oxygen in large quantities can now be produced at from 2 to 5¢/100 cu. ft. (\$5 to \$12/ton). During 1956, 71 billion cu. ft. of oxygen was produced in this country, compared to 12 billion cu. ft. in 1946.

Oxygen hasn't lived up to many of the published predictions of 1946-47. But tonnage oxygen—a term now applied to high (99.5%) or low (95%) purity gas—is having a field day in the chemical and metallurgical industries, with new

applications opening up at a fast

Six companies in this country are strong in the tonnage picture: Linde,* Air Products, American Messer, American Air Liquide and Hydrocarbon Research. Linde mainly produces oxygen as a liquid in centrally located plants, then transports oxygen to customers, where it is evaporated and distributed.

The other four companies, and Linde, engineer and construct ton-

* Linde, Air Reduction and National Cylinder Gas dominate the pure "bottled" oxygen market. nage oxygen plants for lease or sale.

► Important Applications—In this country tonnage oxygen and oxygen producing units have greatly affected three industrial processes:

• The majority of new ammonia plants under construction depend on the Texaco process for preparing ammonia synthesis gas: hydrogen is formed via partial oxidation of natural gas or Bunker C oil with oxygen. Also, new ammonia plants located near a pure hydrogen source (electrolytic cells, reformer off-gas) call for an "oxygen" unit for producing pure nitrogen.

• Acetylene is now made in the country via the important Sachsse process—burning natural gas in the presence of low pressure O₂.

• Steel is produced by direct injection of tonnage high purity oxygen onto the surface of molten iron in a Bessemer-type converter. McLouth Steel in Michigant and Dominion Foundries & Steel in Canada have found this technique gives considerable savings.

As for the future, Olin-Mathieson is trying to apply the Texaco oxidation process to coal. The Bureau of Mines is working on production of gasoline and other fuels by reaction of coal and oxygen. And Shell Chemical is building a new ethylene oxide plant in England designed around direct catalytic oxidation of ethylene with oxygen.

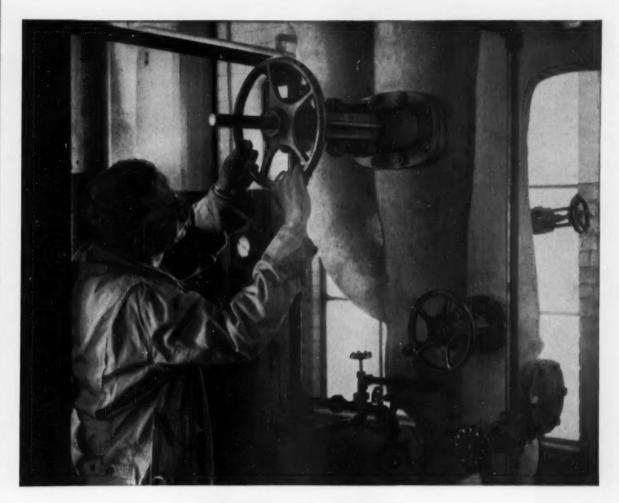
In Germany Badische Anilin has developed an oxygen-thermal process for calcium carbide. And the Bamag process is growing in importance for the production of concentrated nitric acid via ammonia oxidation with oxygen—particularly in Europe.

Process Take Off—Most commercial tonnage oxygen processes in this country take off from the Linde or Claude cycles: Cooled air, under pressure, is depressurized through a throttling valve or expansion engine. This cools the air to a point where it separates as a liquid. Boiling points of nitrogen and oxygen differ sufficiently so separation is possible by fractional distillation.

This is the "basic" process outline. One variation—for the Texaco partial oxidation process—produces 95% O₂ at high pressures (480-520 psig.).

Air is compressed (see flowsheet for 180 tons/day O₂ unit) in reciprocating compressors to a pressure of 580 to 600 psig., scrubbed with

tFor a description of the process see CE, Feb. 1956, p. 122.



Phenol at 350° F. no problem for these Crane Valves

THE CASE HISTORY—Refinery men know that handling hot phenol can be rough on valves and cause a lot of headaches. Or it can be a smooth, efficient valve operation—year in and out—as experienced here at the Continental Oil plant at Ponca City.

These Crane No. 47X 150-pound cast steel gate valves are on phenol service at 60 psi., 350° F. They're on the exhaust line from extraction tower bottoms pump in the aromatic extraction unit.

Installed in 1944, these Crane

valves have required only routine maintenance. Operated about twice a month—they continue to make tight closure with ease—with no leakage or sticking.

Outwardly Crane valves may look like many others. But it's a mistake to assume all steel gate valves are alike.

The difference that's most important to you is inside—for instance, in the extra skill and care that goes into Crane seating design and materials. That's what makes Crane valves such outstanding

performers on refinery services.

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EDITED BY M. A. GIBBONS



Robert L. Hershey: Man of the Month

Chemical engineer takes over leadership of Du Pont's polychemicals department in Wilmington

When you're looking for someone to take on the responsibility of a mammoth operation like that of Du Pont's polychemicals department, you've got to make sure that the man you select is not only mighty sharp himself in his field but able to help his assistants to grow and develop as his protegés. If he knows how to delegate authority to subordinates, he does his company a real service: in so doing, he makes daily operations more efficient and enhances the firm's store of young, capable executives.

But to do it, he's got to be the sort of person who realizes that he's not the only one who's capable of doing a job well, and that, perhaps, there's more than one good way of doing it. So, the man for such a job has to have a healthy faith in other people, in his own opinion of them, and in his ability to lead.

Du Pont believes that the right man to head up its extensive polychemicals work is Robert L. Hershey.

► How It's Done—Hershey was singled out for a couple of good reasons:

It's his belief that "an important part of a manager's responsibility is to develop the people working under him." That's why he likes to do a good job of "coaching" and, then, let subordinates do the actual work. There's no paternalism in his department.

What's more, he knows how to benefit from the responsible judgment he's helped develop in his assistants. Before he makes major decisions he calls them in for a pow-wow, sounds out their ideas and then sifts through the different recommendations. And, once all the available information is on hand, he's not afraid to gamble for high stakes.

For a smoothly running operation, Hershey claims that, "the crux of the matter is in learning the techniques of working together with your staff."

How It Came About—There probably are a lot of talented men in industry who couldn't do such a job effectively. Many of them might know their own measure but when the abilities of

their judgment falls short.

Hershey's career, on the other hand, is an extensive listing of opportunities for gaining insight into the best ways of understanding and guiding young people.

others come up for evaluation

When he graduated from MIT in 1923, he stayed on for post-graduate work. Then he began an eight year stint on the chemical engineering teaching staff. It was during those years that he gained the vital experience working with young people that he draws on so heavily today.

It wasn't till 1936 that Hershey worked into the industrial side of his field. That year, he joined Du Pont at the Wilmington Experimental Station. And, when he did come into industry, he brought with him the theory and techniques of modern chemical engineering which he had gleaned during those years at MIT.

For some three years, he took charge of the semi-works installations in the ammonia department's chemical division. He was appointed assistant research director of the department in 1943 and assistant general manager in late 1948. He continued in that position when, in the following year, the ammonia and plastics sections were consolidated and dubbed the polychemicals department. Then, this year, he became the department's general manager.

Sound Advice—Hershey's own decision to go into the chemical engineering field can be traced many years back to his father's sound advice. The elder Hershey,

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445 State Steet North Haven, Conn. NAMES . . .

who was in the metal working business, was "impressed with what the chemists were doing." He could see that "chemistry was the coming field" and he wanted his son to be in on the thick of it. It sounded like a good idea to young Hershey—and apparently it was.

Today, one of Hershey's own sons (who's now just 14) wants to follow in his father's footsteps. The other boys: ages 20 and 12 are, as yet, uncommitted.

When he's not working with his staff or his children, Hershey finds further challenges as director of the Kennett Township School District, Kennett Square, Pa., where he makes his home. And, recently, he and Mrs. Hershey returned from an extensive. and enjoyable tour of Europe.

Marvin D. Weiss has joined Fischer & Porter Co., Hatboro, Pa., as manager of the analytical division of the research dept.

John C. Koch has been elected president of Fluid Controls Institute for 1956-57 at the firm's recent meeting. Koch is also president of the Philadelphia section of the Instrument Society of America.

A. Eugene Schubert has been named manager of General Electric's chemical development department. He's the former manager of engineering for GE's chemical materials department.

John W. Warner has been promoted to manager of the coatings department, Goodyear Tire & Rubber Co., chemical division.

Henry E. Redd has joined the staff of Gulf Oil Corp.'s petrochemicals department. He'll make his headquarters in Pittsburgh, Pa.

Francis Schaffer is now associated with Gas Machinery Co., in research and development. He's a former employee of Nat'l Cylinder Gas Co.

Ted Kersker has been appointed manager of fabric development for all tire divisions of Goodyear Tire & Rubber Co.

Joseph W. Conlon has been appointed manager of the Rensselaer, N. Y., plant of General Aniline & Film Corp., dyestuff and chemical division.



Seymour Baron

Burns and Roe, Inc., has created a new department—a chemical and nuclear section—and Seymour Baron is its technical director.

For a number of years, Baron has been head of the firm's engineering specialist section. His work has involved many problems in thermodynamics, as well as ore reduction and nuclear fuel purification for the AEC.

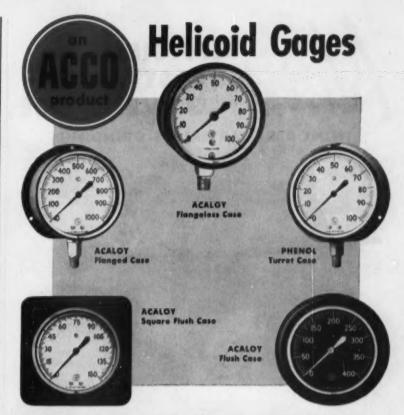
He is a graduate of Columbia University with a degree in chemical engineering. A native of New York, Baron also spent some time as an instructor in power plant thermodynamics at Polytechnic Institute of Brooklyn.

Paul Mayfield, a member of the board of directors of Hercules Powder, has been elected a vice president and member of the firm's executive committee.

Lloyd R. Cooper is now chief metallurgical engineer of the Heppenstall Co., Pittsburgh.

Carl Ludwick, Canton, Ohio, did consulting work on his own during the past summer. Formerly, he was associated with the Bonnot Co., extruder manufacturer.

Frank J. Soday, vice president and director of research and



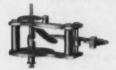
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Teresto, Coasda

NAMES . . .

development for Chemstrand Corp., Decatur, Ala., has received an honorary degree of doctor of science at Grove City College.

Lawrence N. Canjar, associate professor of chemical engineering at Carnegie Institute of Technology, has been awarded a \$6,000 research grant from the Nat'l Science Foundation.



Joseph Schumacher

American Potash & Chemical has appointed Joseph Schumacher to the post of vice president in charge of research.

Schumacher has a long record in research chemistry. Following graduation from the Universities of Illinois and Southern California, he began his career with Carus Chemical Co., in La-Salle, Ill. From 1941 till 1954, he was with Western Electrochemical Co., where he developed many of its processes and products. He joined American Potash & Chemical two years ago.

Under a new organizational setup, research operations at the firm's Trona, Whittier, Los Angeles, Calif., and Henderson, Nev., installations will be centered in a new department—under the new vice president.

Adalbert Farkas has joined the research and development division of Houdry Process Corp. as section chief in exploratory research at the firm's laboratories in Linwood, Pa.

A. E. New is the new director of the technical department at Escambia Bay Chemical's manufacturing division. Formerly, he had been director of process development at Carbide & Carbon's Texas City plant.

Fred W. McLafferty has been appointed director of Dow Chemical's new Eastern Research Laboratory in Framingham, Mass.



W. W. Akers

The new chairman of Rice Institute's chemical engineering department is W. W. Akers. He succeeds A. J. Hartsook who retired recently as chairman but continues as professor of chemical engineering.

Akers did his undergraduate work at Texas Tech. and later continued his studies at the University of Texas and the University of Michigan.

For the past nine years, he has been on the faculty of the department at Rice. He has also been active in consulting work in industry.

Walter P. Barrett has been named manager of the pipe fabrication department of Dravo Corp.'s machinery division, in Pittsburgh, Pa.

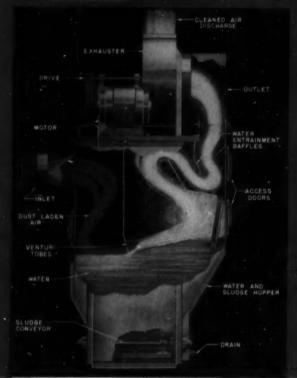
James E. Kearney has been appointed manager and John J. Lynch, assistant manager, of Ebasco Services' industrial engineering division.

William J. Sparks, director of the chemicals research division of the Esso Research & Engineering Co., has received the Distinguished Alumni Service Award from his alma mater—Indiana University.

James F. Adams, Jr., is now general manager of technical service for Allied Chemical & Dye's Solvay Process Div.



NEW PANGBORN VENTRIJET Gives Efficient Wet Dust Control



Efficient wet dust collection depends on breaking water into particles and mixing it with the dust. The new Pangborn VENTRIJET Collector utilizes venturi tubes to achieve this effect. As dust-laden air enters the inlet chamber, heavier dust particles sink to the bottom. The air stream then passes through the venturi tubes at high velocity, drawing water with it and breaking it into minute particles. These particles mix thoroughly with the remaining dust in the air and give the VENTRIJET its high operating efficiency. In the outlet chamber, the resulting sludge settles to the bottom for removal. Eliminator sections remove water droplets in the washed air and the cleaned air is then discharged. The result is peak performance in a minimum of space.

Pangborn VENTRIJET offers these advantages:

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For full details, write to PANGBORN CORPORATION, 2600 Pangborn Blvd., Hagerstown, Maryland.

Panaborn DUST

NAMES . . .

Formerly, he managed Solvay's product section, technical service department.

Carl Pacifico has been appointed to the position of vice president of American Alcolac Corp., Baltimore. He joined Alcolac in 1954 as director of development. New duties include directing the firm's sales program.

Joseph A. Wilk, group leader in the analytical division of the American Oil Co., Texas City, Tex., has been transferred to the firm's new installation under construction at Yorktown, Va. He'll supervise analytical and oil inspection work for refinery product quality.

Ralph J. Paffenbarger, head of the department of Engineering Drawing of Ohio State University, has been cited for distinguished service in his profession by the American Society of Engineering Education.

John B. Seastone has been appointed director of the technical division of Olin Mathieson Chemical. He had been research and development manager for the Metals Division.

Marvin Spielman has been promoted from head of the organic research department to director of research evaluation. In his new position, he will advise the director of research and his staff.

Riley D. Housewright was appointed scientific director of the Army Chemical Corps Biological Warfare Labs at Fort Detrick, Md. He succeeds John L. Schwab, who was recently appointed deputy for scientific activities of the Army Chemical Corps research and development command.

Clyde A. Kitto, manager of the Baton Rouge, La., plant of Solvay Process Div., will now manage the firm's Syracuse, N. Y., works. Gerald L. Walter, assistant manager at Baton Rouge, succeeds Kitto as manager.

I. W. Hamilton has been promoted to group leader in the process development section of the research and development department of American Oil Co., Texas City, Tex.



Monroe E. Spaght

The American Section of the Society of Chemical Industry has just elected Monroe E. Spaght honorary chairman for the year 1956-1957. He succeeds Raymond Stevens, president of Arthur D. Little, Inc., the retiring chairman.

Monty Spaght is executive vice president and director of Shell Oil Co., New York. In addition to direct industrial responsibilities at Shell, Spaght has a continuing interest in programs set up to encourage more young people to go into the field of teaching the sciences. He was recently appointed a trustee of Stanford University.

Spaght is also a director of Shell Chemical, Shell Development, Stanford Research Institute, American Petroleum Institute and the Institute of International Education.

John L. McPherson, materials engineer with Blaw-Knox Co.'s chemical plants division, Pittsburgh, has been elected vice chairman of the technical practices committee of the Nat'l Assn. of Corrosion Engineers.

Benjamin Linsky, chief, smoke abatement bureau, City of Detroit, succeeds H. Kenneth Kugel, chief engineer, div. of smoke regulation and boiler inspection, Washington, D. C.,



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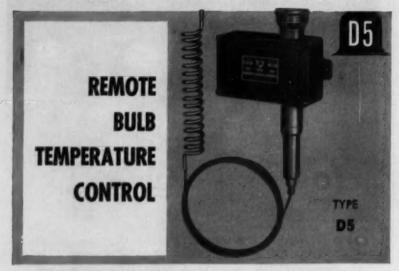
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Temperature Ranges	-150°F. to 200°F., 70°F. to 370°F., 100°F. to 650°F.	
Switch Ratings	15 amps. at 115 or 230 volts A.C. Also 20 amps. or D.C. switches on specification.	
Switch Types	N.O., N.C., or Double Throw - no neutral position.	
On-Off Differential	Approximately 1.0°F. or 2.0°F. dependent on model.	
Adjustment	Three-turn, calibrated knob rotated against graduated barrel. Readings and divisions equally spaced over entire range. Adjustment knob includes calibration screw.	
Electrical Connections	Made to internally located terminal block via clearance hole in the enclosure.	
Capillary Tube Length	Standard length six feet. Other lengths available.	
Enclosure	Die-cast aluminum case with black wrinkle finish. Other finishes available.	
Mounting	Control head surface mounted in any position by means of dog ears. May also be flush mounted.	

Complete information on the Type D5 appears in Section 200 of UNITED ELECTRIC's new catalog. Section 200 contains detailed data on UE's complete line of remote bulb temperature controls. This information is clearly stated and attractively illustrated. Send for your copy now.





NAMES . . .

as president of the Air Pollution Control Association.

D. L. Wiley, production supervisor, has been promoted to department head in the solvent vinyl resins plant of Carbide & Carbon Chemical in Texas City, Tex.

Reed O. Hunt has been elected a director and a member of the executive committee by the directors of Crown Zellerbach. He has been vice president for operations since 1954. The new vice president for manufacturing and construction is E. W. Erickson.



William A. Raimond

American Cyanamid's new technical director for the organic chemicals division is William A. Raimond,

Assistant technical director since 1955, Raimond replaces James F. Bourland, who has been named technical director of Cyanamid's new engineering and construction division.

He joined the firm in 1942 after a few years on the Rutgers University teaching staff. He soon became assistant chief chemist of the vat dye development department and later chief chemist of the same group. In 1949, he became technical director of the dyes department and in 1954 he took over similar duties for dyes and related products.

Charles E. Brown has been appointed executive vice president of Chemstone Corp., subsidiary of Minerals & Chemicals Corp. of America.

Victor K. LaMer, professor of chemistry at Columbia University, has been elected to membership in the Royal Danish Academy of Sciences and Letters, division of Natural Sciences and Mathematics.

- H. D. Sullivan, J. R. Mier, and J. W. Parmer have been transferred from Dow Chemical's Texas division to the Louisiana division in Baton Rouge, as supervisors of organic chemicals production.
- N. C. Robertson, director of research, Escambia Bay Chemical Corp., has been appointed vice president of the firm.
- P. H. Holt II was appointed manager of the new process licensing staff of Esso Research & Engineering Co. Holt earned his bachelor's degree in chemical engineering from MIT in 1930.
- Henry E. Little has been appointed general superintendent of Cleaver Brooks' Lebanon, Pa., plant. He had been associated formerly with the Phoenix Iron & Steel Co., Harrisburg, Pa.
- Edward V. Burnthall has been promoted to senior section leader with Chemstrand Corp. He will take charge of the dyeing and finishing division of the research and development department.
- William L. Evers has been appointed assistant manager of fiber research of Celanese Corp. of America. His primary responsibility will be for fiber polymer research in the firm's Summit, N. J., research labs.
- W. F. Brown has been promoted to the newly created position of assistant manager of manufacturing for Continental Oil's Rocky Mt. region.
- William N. Lacey, dean of graduate studies at the California Institute of Technology has resigned his position in order to devote full time to teaching and research. A professor of chemical engineering, he won wide recognition for his investigations of the proper-



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ties and behavior of hydrocarbons.

George C. Wilsnack has received an honorary doctor of science degree from the University of Denver. He is Ideal Cement's director of research.

I. John Wansik is now manager of the Cincinnati district staff of Commercial Solvents' industrial chemicals department. He is a graduate chemical engineer from the University of Iowa.



W. A. Bittenbender

The new director of Sharp & Dohme's production and engineering division is William A. Bittenbender.

In his new position, Bittenbender will be responsible for all phases of production, engineering, and production and materials control. He joined the firm in 1955 after serving as associate director of chemical control for the Merck Chemical Division in Rahway, N. J. Before his present appointment, he had been the president's technical assistant.

Dr. Bittenbender is also the author of articles reporting research in the fields of antiseptic activity of fluorinated hydrocarbons and antibiotic isolation. He holds many patents as a result of these studies.

Edwin Hart has been appointed an assistant superintendent of the film emulsion division, Eastman Kodak Co. He has been with the firm, in that division, since 1936.

Bruce K. Brown has been designated president of Petroleum Chemicals, Inc. Brown, former deputy administrator of the Petroleum Administration for Defense, is currently president of Pan-Am Southern Corp. but will join Petroleum chemicals later in 1956 when Pan-Am merges with another firm.



A. E. Schubert

General Electric has named A. Eugene Schubert as manager of its chemical development department.

Formerly manager of engineering for GE's chemical materials department, Dr. Schubert is a native of Kansas City, Mo. He received his B. S. degree at the University of Illinois in 1936 and did graduate work at Pennsylvania State University.

Soon after joining GE in 1942, he helped create plans for the firms new silicone plant at Waterford, N. Y. Then, in 1945, he became head of the research laboratory's chemical process section.

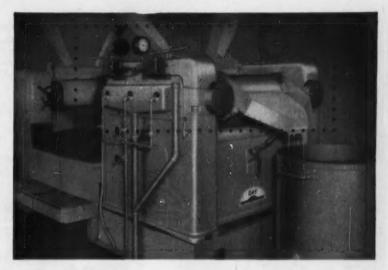
Schubert is a member of the Chemists' Club, the AIChE and the ACS.

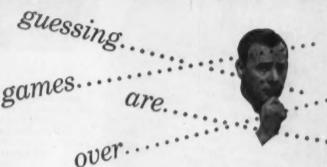
Bernard S. Friedman has been promoted to research associate of Sinclair Research Laboratories, Inc., in Harvey, Ill.

Glan H. Shoptaw and Alfred E. Withrow have both been promoted from senior chemical engineers to supervising engineers at Monsanto Chemical's Texas City, Tex., plant.

Van Horn Ely, Jr., has been named president of Oxy-Catalyst, Inc., Wayne, Pa.

R. A. Wilkins, vice president, research & development, Revere Copper & Brass, Inc., has been elected a fellow of





DAY HYDRA-SET... a unique hydraulic roll-setting device that takes all the guesswork out of roll settings... developed by DAY engineering, field tested with spectacular results. One simple setting gives unvarying accuracy to your roll mill work, resulting in absolute uniformity of every batch of pigmented product. With the DAY Hydra-Set your roll position is absolutely constant once you make the setting.





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the Institute of Metals, London, in recognition of his outstanding services to the Institute.



Robert M. Burns

The Edward Goodrich Acheson Gold Medal and prize of the Electrochemical Society, Inc., will be presented to Robert M. Burns-scientific advisor to Stanford Research Institute and to the Aprague Electric Co.

Burns will receive the award at a dinner meeting of the Society on October 2. The Acheson Award is made once every two years for conspicuous "contribution to the advancement of the objects, purposes, or activities" of the Society.

Formerly, Dr. Burns was associated with Bell Telephone Laboratories as chemical director. During World War I, Burns served with the Chemical Warfare Service. And, prior to his association with the Bell Labs, he worked as research chemist with the Barrett Co. and as a member of Western Electric's technical staff.

George Seybold has been elected vice president of Rust Engineering Co. Formerly, he had served as vice president and assistant general manager of Chemical Construction Corp.

James B. Rea, president of the J. B. Rea Co., Santa Monica, Calif., was invited to present a paper at the "International Congress on Automation," held in Paris in June. Rea chose the subject of "Management Feedback Controls."

L. C. Brandt has been named general manager of the new plant currently being set up in Kansas City, Kans., by Reichhold Chemicals, Inc.

George J. Marlowe has been appointed director of project evaluation for Scientific Design Co., Inc. Marlow joins SD after six years with American Cyanamid's organic chemical division.

Carroll N. Rill has been appointed director of research for Murphy-Phoenix Co., Cleveland.

Charles Warner Plummer has been named director of research for National Northern, the technical division of Nat'l Fireworks Ordnance Corp.

Walter J. Hamburger, director and treasurer of Fabric Research Laboratories, Dedham, Mass., is the 1956 winner of the Olney Medal of the American Association of Textile Chemists and Colorists.

OBITUARIES

Thomas McLaren, 69, an officer and a director of Crown Zellerbach Corp. for 21 years, died June 21 of a heart attack at his Hillsborough, Calif., home.

Burton R. Colkett, 61, vice president and secretary of Fibreboard Paper Products Corp., died June 21, of a heart attack at his San Francisco home.

James J. Jang, 39, development engineer of the Fluor Corp., Ltd., Los Angeles, was killed in the mid-air collision of two commercial airliners at Grand Canyon, Ariz., June 30.

L. D. Cook, corrosion engineer with Bart Mfg. Corp., was killed in the commercial airlines tragedy at Grand Canyon, Ariz., on June 30. Formerly, he was head materials engineer with Wyandotte Chemicals.

Philip Arnold, 73, retired vice president of the Garlock Packing Co., Palmyra, N. Y., died July 3, in Carmel, Calif.



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Letters: Pro & Con

C. H. CHILTON

Pro: Adequate Perquisites

In the July Pro & Con (p. 343) a letter from Mr. Joseph Byrne on the subject of the Northrup article ("You Could Be Treated Better") puts "salary and prerequisites" in quotes. I assume this is quoted correctly from the

Should not the word be "perquisites"?

W. M. Woods Carbide & Carbon Nuclear Corp. Oak Ridge, Tenn.

► Reader Woods is right, and we can't blame this error on the printer.—ED.

Pro: Vertical Condenser

Sir:

In my article on "Trends in Fatty Acid Distillation" (July 1956, pp. 189-194), the point is emphasized that in condenser design a vertical condenser has some definite features in its favor. And you show the condenser on p. 194 in horizontal position!

CHESMAN A. LEE

Evanston, Ill.

► We suggest that our readers make a note at the left-hand side of the condenser sketch reading "This End Up."—ED.

Why Hide Good Material?

Sir:

I would like to comment on your very opportune remarks on "The Shortage of Scientists and Engineers" in your July

issue (pp. 256-7).

This morning, in a discussion with my chief, Mr. W. R. Metcalfe, together with other division leaders, I mentioned this article. When trying to find it, though, what a time I had! After looking through all the indexes and references, including the Guided Tour that I had boosted so to my fellow workers, I had to give up and use the time-worn "Hunt" system, page by page (and my chief doesn't like waiting).

Why should one of the most

important articles be hidden in the middle of the book where you can't find it when you want it?

Mr. Metcalfe, by the way, was at the International Standards Organization meeting held in Spain this spring. He was Canada's sole (and first) representative for the pressure-vessel code discussions. His impressions, after meeting, hearing and observing the Soviet engineers, agree with your remarks exactly.

A. LEWIS

Foster Wheeler Ltd. St. Catharines, Ont.

The answer to Mr. Lewis's question about indexing the McGraw-Hill editorials could get rather involved, but boils down simply to this: Location of this material in the book is determined in relationship to the makeup of advertising forms, and page numbers are not available in time to include in Guided Tour. We regret that this situation sometimes causes our readers inconveniences similar to that experienced by Mr. Lewis.—ED.

More Oxygen Plants in U.K.

Sir:

We note in your April 1956 issue (p. 138) a news item about oxygen plants in the United

Kingdom.

We would call your attention to the fact that the last part of your story is not true. Stewarts & Lloyds Ltd. are not building an oxygen plant; they are purchasing a 200-ton/day plant from us. We manufacture oxygen generators under license from Air Products Inc., Allentown, Pa.

We have secured a further contract for a large oxygen/nitrogen plant to be installed at the Billingham Div. of Imperial Chemical Industries Ltd. This plant will produce 240 tons of high-purity oxygen per day and will also produce 400 tons of very high-purity nitrogen per day.

Contracts for smaller plants have also been secured from Newport Div. of Steel Co. of Wales Ltd. and British Celanese Ltd. Orders secured to date for various types of oxygen/nitro-



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E. I. du Pont de Nemours & Co., Inc. Wilmington 98, Delaware

PRO & CON . . .

gen plants are now valued at considerably more than one million pounds.

A. A. C. ROBERTSON Butterley Co., Ltd. London, England

Boon to Nonmetallurgists

Regarding the article, "Selecting Wear-Resistant Materials," by Lutes and Reid (June, pp. 243-246), I wonder if my ex-perience isn't typical.

As corrosion engineer for my company, I have found myself called upon more and more frequently to make recommendations on wear-resistant materials for all sorts of abrasive services. Since I'm not a metallurgist, it hasn't been easy, as a rule, to dig out the factual information required to make an intelligent recommendation.

Your article provides in convenient, practical form the basis for making an intelligent choice of wear-resistant materials. It should prove a boon to those engineers who must select such materials without benefit of metallurgical training.
PAUL J. GEGNER

Columbia-Southern Chemical

Corp. Barberton, Ohio

Pro: Slice of Blue Pie

I read with very much interest your article in the May issue, "Rosy Outlook for Blues and Greens" (pp. 138-140). Ansbacher-Siegle Corp. has

been manufacturing phthalocyanine blue pigments for some time as well as being a basic manufacturer of phthalocyanine green pigments. Inasmuch as your article did not list our company, we wish to take this opportunity to inform you that we have for some time been "vying for sizeable slices of the pie."

I do want to compliment you on the way in which you presented this article on the everexpanding growth of phthalocyanine pigments.

ERIC N. BLACKSTEAD Ansbacher-Siegle Corp. Rosebank, N. Y.



Pro: Life in the Islands

Sir:

Two beachcombers who enjoy the warm Hawaiian sunshine my wife and I—are looking for projects in numerical analysis to work by mail.

We especially like to work and advise on the fitting of curves and surfaces to make empirical functional data available to high-speed computing machines. Such work is our specialty, but we also welcome other problems in numerical analysis.

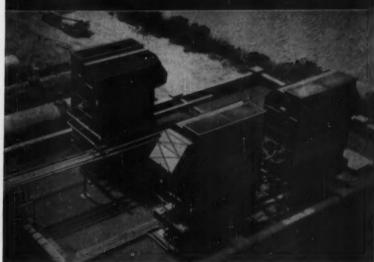
Our office consists of two bedrooms and a portion of the kitchen. Our equipment consists of two Monromatics, and Ozalid machine, a spirit duplicator, a printing press, a typewriter, a four-drawer letter-size file, a desk, a kitchen table, a card table and numerous small items which help to give the house a slightly cluttered appearance.

The personal problem that we undertook to solve was that of living on an island while continuing to eat. Our approach was wonderfully straightforward but has very little else to recommend it.

We moved to Oahu and bought a house. We started looking for jobs and found that there weren't any. We bought a Monromatic and started writing, "We're in business!" We're in business!"

For a long time the only response we got—we didn't get much—generally read, "I don't have anything for you now but

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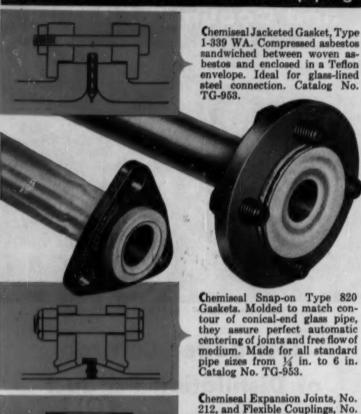
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U.S. GASKET - BELMONT PACKING

PRO AND CON . . .

if you ever need an assistant, please keep me in mind."

It is perhaps well to emphasize that success—we're still eating—came only after great labor and many bad moments. Otherwise, the islands might become flooded with numerical analysts all trying to do business by mail. The company would be very stimulating but the competition would be terrific.

Aloha.

CECIL HASTINGS

Lanikai, Hawaii

Con: Premature Pilot Plants

There is little I can add to Mr. Grothe's fine article in your June issue ("Modern Approach to Pilot-Plant Design," pp. 239-242) except to emphasize his one point that pilot planting should not be undertaken until all factors have been tested in the laboratory.

Pilot plants are expensive to operate in terms of both time and money. All too frequently they are used to gather information that is obtainable from laboratory work in less time at far lower cost.

Mr. Grothe's article should be required reading for all chemical engineers.

R. W. GRIMBLE

E. I. du Pont de Nemours & Co.
Wilmington, Del.

► Acceptance of Mr. Grothe's ideas was not exactly unanimous, as witness the following letter.—ED.

Con: Pilot Plant Philosophy

Sir:

I found the article, "Modern Approach to Pilot-Plant Design," of considerable interest. While I agree with many of the things which Mr. Grothe says, I cannot agree with his basic philosophy.

Mr. Grothe's "modern" approach is not entirely new. Others have suggested a moratorium on invention; he suggests it on process improvement.

Whenever the research people have developed a process far enough to demonstrate workability and commercial attractiveness, he proposes that they

turn it over to the design engineers and thereafter keep their hands off. "The pilot plant should be a confirmation of the interpretation of laboratory tests. . . . The man who will eventually carry the responsibility for the design of the ultimate plant should also play a major role in the design of the pilot plant . . . and be closely allied to its operation. . . . Research should sit back."

In other words, the design has been frozen. There's no need for further research.

This philosophy might be practical in fields where changes occur slowly, but if applied to new processes for the manufacture of organic chemicals, it would result in many plants which were obsolete before they even came on stream.

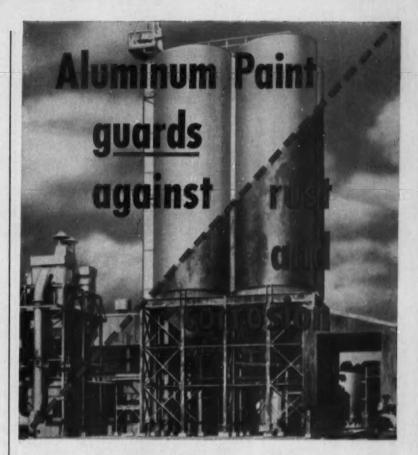
No matter how thorough the laboratory research, the initial plant design for any complex new process will fall far short of perfection. The problems encountered in starting up and operating a complete pilot plant are sure to suggest process improvements.

Granted, many ideas will come from the design engineers, pilotplant supervisors and operators. If, however, the research people who conceived the process are not encouraged to follow its pilotplant development, one of the most fertile sources of processimprovement ideas will be lost.

The chemical industry looks to the pilot plant not only as insurance against errors in the design engineers' interpretation of laboratory results, but especially as an opportunity to do further process development.

We should not expect the research man and the design engineer to think alike. The true research man is never satisfied. He is always looking ahead to additional process improvements, if not to a completely new process. In contrast, the design en-gineer wants to freeze designs so he can get a plant built.

For these reasons, pilot plants in the chemical industry are usually designed and operated by a group of specialists, top-notch chemical engineers who by training and experience have learned to work with both the laboratory research group and the design



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rely on the high quality of genuine Reynolds Aluminum Pigments, we'll gladly send you the list. Just use the coupon below.

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engineering group and to utilize the unique contributions of both in the design and operation of their pilot plants. They strive not only to prove out the original flowsheet but simultaneously to evaluate and incorporate as many process improvements as they can without delaying the ultimate commercial plant.

R. S. EGLY Commercial Solvents Corp.

Terre Haute, Ind.

Pro: Sharing the Credit—I

We read with interest your article, "More Uranium Secrets Can Now Be Told" (May 1956, pp. 124-132), and were rather surprised to see Dow credited with development work on the resin-in-pulp process for the recovery of uranium.

While it is true that Dow Chemical Co. has done considerable development work on resins for use in this process, credit for the concept and development of the process should go to the AEC Raw Materials Development Laboratory (operated by Massachusetts Institute of Technology), American Cyanamid Co. and National Lead Co. during the period of this development.

RICHARD H. BAILES

Dow Chemical Co. Pittsburg, Calif.

As we pointed out, "Many different individuals and groups helped put ion exchange into the (uranium) flowsheet." It's gratifying to learn from the above letter and the one which follows that those who were mentioned specifically in our story are so anxious that due credit be given to all.—ED.

Pro: Sharing the Credit-II

Sir:

In your article on uranium recovery via ion exchange (May 1956, p. 124), you make the statement, "Permutit Co. claims credit for independent work, particularly on the chemistry of the process."

This statement is somewhat misleading, and the phrasing "claims credit" tends to create the erroneous impression that we want credit for developing the chemistry of the ion-exchange uranium recovery process.

This is not so. The early development of the ion-exchange process was carried out under AEC contract at Oak Ridge, Battelle Memorial Institute and MIT Metallurgical Laboratory in 1949-50. These groups and the subsequent AEC contractors concerned should get this credit.

We believe that the following statement indicates more appropriately the manner in which Permutit fitted into this picture:

The feasibility of recovering and concentrating anionic metal complexes in solution by anion exchange was realized more than 10 years ago by research workers of Permutit Co. Among the metals investigated were those of Group VI-B, including chromium, molybdenum, tungsten and uranium. This work was published in technical journals and resulted in the granting of several patents.

J. P. TERMINI

Permutit Co. New York, N. Y.

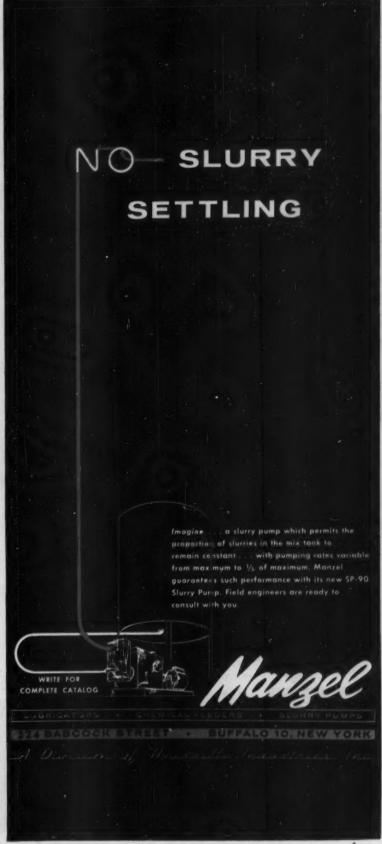
Con: Wet Blankets on Ideas Sir:

I was quite interested in a recent exchange of letters (May 1956, pp. 308-310) between a Plant Notebook Contest winner (Dec. 1955, p. 216) and a critic of the system which won your annual award.

The use of condensate at the pump packing for lubrication purposes indicates to me an ingenious use of an available utility. Naturally, no universality of application was intended, since the proper pressure relationship (between condensate source and pump seal) may not be readily on hand.

The use of a water service line to provide seal lubrication seems to be quite questionable, and its application therefore quite limited. When using city water on "hot" pumps, there is a pronounced tendency to form mineral deposits in packings, compared to the distilled water available in the form of steam condensate.

In general, I would question that type of criticism which presupposes a universality of ap-





PRO AND CON . . .

plication for any idea which is unique and different. Rather, it is the "on-the-spot" solution to a difficult problem which is of great interest to the readers.

LEO ADAMS

Celanese Corp. of America Newark, N. J.

Number of ejector stages	Absolute pressure range,
1	As low as 100 mm.
2	100-20 mm.
3	20-2.5 mm.
4	2.5 mm300 microns
5	300-50 microns
6	as low as 2 microns at no load

Pro: Well Defined Ranges

Sir:

I found the section on handling compressible fluids in the June issue (pp. 175-238) very well done and particularly liked your editing on my article about steem interiors.

steam jet ejectors.

I should like, however, to call your attention to the bar chart on p. 197 which shows the range of ejector suction pressures. One might imply from the way this chart is set up that all multistage ejectors may be designed for use at any suction pressure over the range defined by the lower pressure limit at one end up to atmospheric pressure at the other end.

A less ambiguous way to present the true pressure ranges for ejector design accompanied my original manuscript and is submitted again herewith in order to clear up any possible misconceptions.

R. FRUMERMAN

Elliott Co. Jeannette, Pa.

Con: Trial and Error-I

Sir:

I have been an interested reader of your Chemical Engineering Refresher series. I am sure that these articles have been as helpful to many others as they have been to me.

Eqs. (15) and (16) of the March 1956 Refresher article caught my eye. It did not look as if the intermediate equations would reduce to Eq. (16). When allowance was made for the misprint of the exponent outside, rather than inside, the bracket, all was clear.

Eq. (16) can be solved systematically rather than by trial and error. The simplest method seems to be the use of series. Newton's tangent iteration method can also be used for the largest values of a and β with a five-place logarithm table, but that is hardly adequate for the smaller a and β values.

The calculated values of y are:

These are not constant, and none is equal to 0.50, as stated in the article. This, of course, does not affect the value of the hypothetical problem in teaching the method.

P. G. SMITH

Sharples Chemicals Div. Pennsylvania Salt Mfg. Co. Philadelphia, Pa.

Con: Trial and Error-II

Sir:

I am certainly interested in seeing from Mr. Smith's letter that there is an explicit solution for the equation

 $a=(\beta''-1)/\gamma$ We had been solving this equation either by trial and error or by a graphical method. The use of series will simplify this and we shall try it out. If in the future I revise or rewrite the Refresher articles I shall incor-

THOMAS E. CORRIGAN Olin Mathieson Chemical Corp. Brandenburg, Ky.

porate Mr. Smith's suggestion.

► Readers interested in the series expression for this equation may correspond directly with Mr. Smith.—ED.

Pro: KO Covers

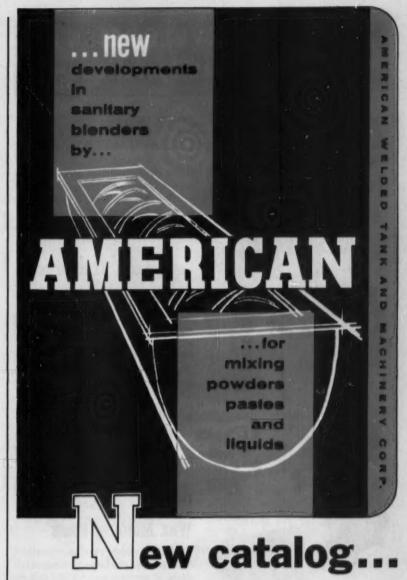
Sir:

Your June cover is a knockout! Congrats.

I wonder if I might have a couple of tear sheets to show the boys in our Art Dept. what makes good design.

DICK REEVES

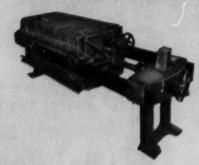
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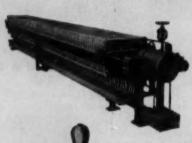
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George O. G. Löf

SOLAR ENERGY. PAGE 175

George Löf, consulting chemical enginer of Denver, has had a long-time interest in the utilization of solar energy and is one of the country's authorities on this subject. He was one of the guiding spirits of last Fall's World Symposium on Applied Solar Energy, held in Arizona, and is a leading champion of the idea that chemical engineers will play a large part in future solar energy development and utilization.

Born and raised in Colorado, Löf received his BS degree at the University of Denver in 1935, and his DSc at MIT in 1940. His professional life has been divided into three principal phases: teaching, directing research, and consultation, all in the field of chemical engineering. He taught at MIT and the University of Colorado, later headed the department of chemical engineering and the Institute of Industrial Research at the University of Denver. He has consulted for such organizations as American Window Glass Co., Colorado Fuel and Iron Co., and North American Aviation. He is a project associate of University of Wisconsin's Solar Energy Laboratory and a staff member of Resources for the Future, Inc.

As evidence of Löf's solar energy interest, three-quarters of his dozen principal publications have dealt with one or another aspect of the subject. In addition, however, his interests range from thermodynamics and rate phenomena on the one hand, to

Authors ...

furnace design, heating and ventilating, chemical plant design and chemical economics, on the other.

Löf's professional activities include membership in AIChE, ACS, ASEE, Sigma Xi and Tau Beta Pi. He is a licensed professional engineer in Colorado. All this still leaves time, as he says, for trying to keep up with his four children, and for indulging his hobbies of photography, camping and fishing.



Zbigniew Dobrowolski

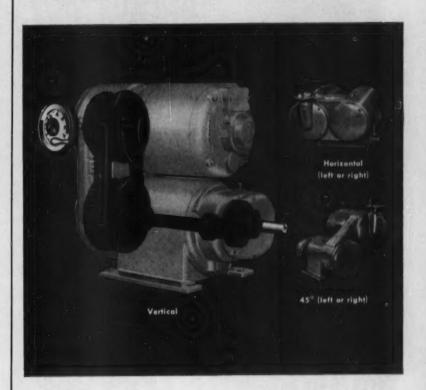
HIGH VACUUM PUMPS. PAGE

Development is the common thread that runs through the industrial experience record of Zbigniew Dobrowolski. He is now a project engineer on development of rotary and high vacuum pumps at Kinney Mfg. Div., New York Air Brake Co., Boston, Mass.

Prior to joining Kinney, Dobrowolski was engaged in the design and development of transfer mechanisms used in producing incandescent electric light bulbs at Bloomfield Lamp Div., Westinghouse Electric Corp.

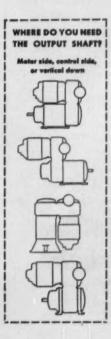
In Glasgow, Scotland, he was associated with Vacuum Industrial Applications, Ltd. Among his activities with this concern were design and development of diffusion pumps ranging from 2- to 10-in. size. Also, he developed equipment for the vacuum metallizing of plastics. This project also included development of lacquers for base and top coating

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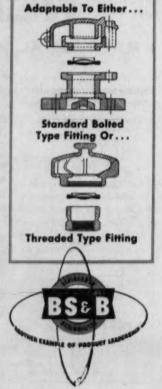
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Safety Head Division, Dept. 2-N9 7500 East 12th Street, Kansas City 26, Mo.



AUTHORS . . .

the vacuum metallized materials. Dobrowolski's formal collegiate training was obtained at the University of London which awarded him BS and EE degrees, During the war, he served with the 2nd Polish Corps, British 8th Army in the Middle East and

Italy.

While it is well-known that "nature abhors a vacuum," Dobrowolski does not let his close association with vacuum come between him and nature. During his leisure time he gets as close to nature as possible, with skiing in the winter and hiking, swimming and camping in the sum-



S. R. M. Ellis

HOW MANY STAGES TO EX-TRACT SOLIDS? PAGE 185

S. R. M. Ellis has the title of reader in chemical engineering at the University of Birmingham, Birmingham, England. Following several years of experience in the design of chemical plants he joined the University staff in 1947 where his duties include supervision of design problems and lecturing on unit operations, while he heads research work on distillation and liquidliquid extraction.

The Department of Chemical Engineering at Birmingham is one of the largest in Europe. It takes in some 70 undergraduates per year and also gives diploma and post-graduate courses. Its Research School is attended by some 60 to 70 candidates for the

PhD degree.

Ellis was born a New Zealander, all of which supports the fact that interest in chemical engineering today knows no geographical boundaries. He has published more than 30 research papers in the field and takes a very active interest in the affairs of the Institution of Chemical Engineers. He is a past associate member of the Institution's Council, a past honorary secretary of the Midlands Branch, and at present a committee member of the Institution.



Donald Q. Kern

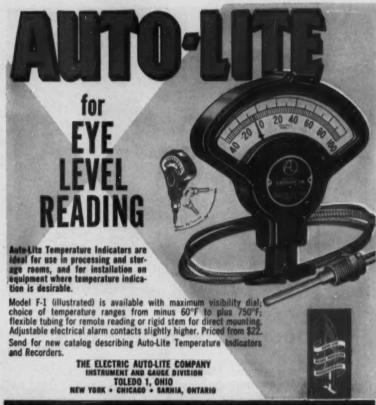
A NEW PROCESS TOOL: LOW FINNED TUBING. PAGE 189

Donald Q. Kern is well known to chemical engineers as an authority on heat transfer.

He studied at MIT and Polytechnic Institute of Brooklyn. From 1937 to 1940, he served as process engineer with the American Molasses Co.; from 1940 to 1948 as department head in heat applications, Foster Wheeler Corp.; and from 1948 to 1953 as Director of Engineering, Process Division, The Patterson Foundry & Machine Co. In the latter capacity, he designed and built plants throughout the western hemisphere.

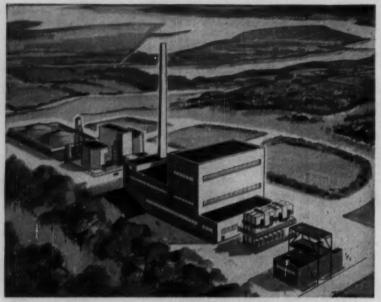
Last year he established his own thermal design and application organization, D. Q. Kern Associates, with offices in Cleveland, New York and Washington. His firm is currently retained by divisions of Union Carbide & Carbon Corp., Calumet & Hecla, Inc., Pittsburgh Plate Glass Co., Canadian Vickers Ltd., York Corp., Battelle Memorial Institute, and several general engineering firms. The firm includes a supporting staff of fifty.

Concurrently, after receiving his PhD in 1942 from Brooklyn Poly via evening classes, Kern served from 1942 to 1953 at that



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- The Babcock & Wilcox Company, builders of the Indian Point reactor, has awarded Vitro a contract for architect-engineer services on the reactor building.

Vitro Engineering leadership in nuclear engineering is also shown by:

- Its selection as architect-engineer for Lockheed Aircraft Corporation's atomic aircraft research center at Dawsonville, Ga.
- Provision of conceptual design for two new types of research reactors for the Army Corps of Engineers at Fort Belvoir, Va.
- · Preliminary design of heavy water plant for the Government of India.

The selection of Vitro to handle these key projects, and others, reflects solid performance in modern nuclear engineering design.

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Alircraft components and ordnance systems

institution as professor of chemical engineering in charge of graduate instruction in thermodynamics and heat transfer. From 1946 to 1950 he assembled and prepared his widely read text, "Process Heat Transfer" (McGraw-Hill), now in its fourth printing.

He is also professorial lecturer in chemical engineering at Case Institute of Technology, and a registered professional engineer. Author of numerous articles on heat technology, he is an active member of AIChE and ASME—having lectured before numerous local sections of both societies.



Paul B. Stewart

DOES CHEMICAL ENGINEER-ING PAY? PAGE 192

Back in the early '30s Paul B. Stewart, then still an unworldly pre-college youth, held a rather startling general office job. Each prestige-packed promotion guaranteed a healthy cut in salary. Perhaps this anomalous situation was the first to pique Stewart's curiosity about the relationship between men and their jobs. At any rate, a growing curiosity over the years led to his penetrating analysis of the chemical engineer's relative economic position, "Does Chemical Engineering Pay?" appearing in this issue.

Washington State born and bred, Stewart first surveyed the chemical scene in 1938 from the University of Washington, BS degree in chemistry in hand. The lack of jobs for chemists sent him directly back to the campus. He emerged four years later with a master's in chemical engineering. A trip south, where he accepted a post as part-time in-

structor while he earned his doctorate from the University of Texas in 1945, prepared him for his second look.

Now excellently equipped, Stewart joined Du Pont's Jackson Labs at Deepwater, N. J., as a research engineer. For four years his work there covered a wide range of projects including petrochemicals, dyes, phthalocya-nine pigments. But he had been bitten by the campus bug, developed a taste for the challenge of teaching, and the adventure of

university research.
In 1949 he joined the chemical engineering department of the University of Southern California as an assistant professor. In 1951 he settled at the University of California as an associate professor of mechanical engineering. Teaching primarily fluid mechanics, thermodynamics and mass transfer, Stewart also heads up research programs in vacuum technology, fuel combustion and, most recently, demineralization of seawater. He has published extensively in these fields.



Donald E. Garrett

PUT COLOR TO WORK IN YOUR PLANT. PAGE 195

Donald E. Garrett is assistant manager of research for the American Potash & Chemical Corp. at Trona, Calif.

A safety-conscious chemical engineer in a safety-conscious company, Garrett has been very active in establishing safety standards at Trona. With his urging, American Potash set up a uniform color code project covering laboratory, pilot plant and full scale operations. Much of this work is reported in his article.





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AUTHORS . .

Starting out as a chemist, he obtained a BS degree at the Univ. of California, then quickly followed this with graduate work in chemical engineering. He left California to attend Ohio State University, earning a PhD degree in chemical engineering in 1950.

Returning to California, he worked for two years with Dow Chemical and Union Oil in process development and plant design, then joined American Potash. He now heads up the plant development and corrosion investigation groups. Both are working on problems connected with increasing the yield of materials produced from Searles Lake, as well as on new products.



William A. Jordan

PUT COLOR TO WORK IN YOUR PLANT. PAGE 195

William A. Jordan, coauthor with Dr. Garrett, is a technical illustrator with American Potash & Chemical Corp. at Trona,

He has a BS degree in commercial art from Woodbury college in Los Angeles. Continuing his training at the Art Center School, he majored in technical illustration and theory and application of color.

After working in the Los Angeles area for a number of years he joined the research department of American Potash at Trona—170 miles from Los Angeles, on the northern end of the Mohave Desert—in 1953.

Current assignments are: establishment of a color code system, and a study of the general problem of how to use color effectively in the laboratory and plant.



Robert D. Norton

MECHANICAL SEALS FOR HANDLING ABRASIVE LIQ-UIDS (A CHEMICAL ENGI-NEERING REPORT). PAGE 199

R. D. (Bob) Norton is a man with a mission, so far as pumps are concerned. Your reporter—having lunched with him several times—knows that he'd rather talk pumps than eat, and that he'd rather see a pump do its job better, than sell one. For he is a pump sales engineer, in fact, New York sales manager for Dean Bros. Pumps, Inc., of Indianapolis.

Norton is a native of Pittsburgh, and a 1942 BS graduate of the U. S. Naval Academy. His five years of active duty with the Navy were divided between sea duty in both the Atlantic and the Pacific aboard cruisers and destroyers, and a like period at Norfolk engaged in organization and teaching at the Navy Damage Control School. Resigning in 1947 he took sales engineering training with Worthington, then in 1948 joined the Pacific Pumping Co., at Oakland, Calif.

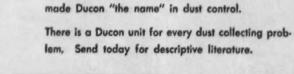
From 1950 to 1956 Norton was branch manager of Harris Pump & Supply Co., in Charleston, W. Va., where he handled a widely diversified line of positive displacement and centrifugal pumps, and spent his time among the process and coal producing industries of the Kanawha Valley and environs. His contacts with process pumping, and abrasive pumping problems, were therefore many and varied.

Early in 1956 he joined Dean Bros. as New York sales manager which, through proximity of our own headquarters, gave added impetus to the completion of this Report. He had been



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AUTHORS . . .

working on it for over a year, since the appearance of his wellremembered article, "13 Ways to Solve Packing Problems."

Norton's interests are numerous and diversified. He is a registered mechanical engineer in West Virginia and a member of the NSPE. He keeps up his old Naval Academy ties, but at the same time expands his peacetime interests via civic and professional activities.



L. P. Sudrabin

CONTROLLING CORROSION IN WATER SYSTEMS. PAGE 236

L. P. Sudrabin is director of engineering services and development, Electro-Rustproofing Corp., Belleville, N. J. He graduated from Northeastern University in 1936, as a BS in ChE.

Prior to joining Electro-Rustproofing, Sudrabin was a research engineer with the Dorr Co., chief chemical engineer with Dayton Power and Light Co., and chemist with the Boston Edison Co.

He is a member of the AIChE, Electrochemical Society, National Association of Corrosion Engineers, National Society of Professional Engineers—and is a registered professional engineer in the states of Ohio and New Jersey.

Sudrabin is chairman of several technical committees of the National Association of Corrosion Engineers.

Since the beginning of the year, he has spent several months consulting on corrosion problems in petroleum production, pipelines, process equipment, marine structures and ships in Lebanon, Syria, Jordan, Saudi Arabia and in the Caribbean.

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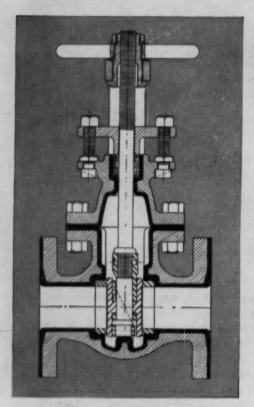
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THIS MONTH'S

Technical

Modern Look at Classics

MECHANISM OF ORGANIC CHEMICAL REACTIONS. By E. de Barry Barnett. Interscience Publishers, Inc., New York. 295 pages. \$4.75.

Reviewed by J. R. Mayer

There are relatively few small volumes available to the student of organic chemistry which clearly and concisely present, in an organized manner, classical reactions viewed in terms of present-day mechanistic theory. This text is such a volume and is "a brief account of modern views of the mechanism by which some familiar reactions of organic chemistry take place."

Chapter I is an introduction containing a valuable review of such important topics as mesomerism (resonance), inductive and electromeric effects, conjugation, hyperconjugation, kinetics, transition state theory, catalysis and hybrid orbitals.

Chapters II and III treat substitution reactions. The first of these deals with aliphatic $S_n 1$ and $S_n 2$ displacements along with the more specialized $S_n 1$, $S_n i$, $S_n 1'$ and $S_n 2'$ reactions. The second is concerned with aromatic substitutions interpreted in terms of electrophilic, nucleophilic and free-radical reagents.

Chapters IV and VII contain a survey of molecular rearrangements. Chapter V is a mechanistic study of double-bond addition reactions in which the stereochemical aspects involved are also carefully considered. Chapter VI is a review of elimination and cyclization mechanism in terms of a few selected examples. Here, as in other portions of his text, the author has maintained a good balance between the theoretical and classically familiar material in order to develop an interesting discusgion.

Chapter VIII covers miscellaneous reactions not involving rearrangements and handles the Kolbe reaction; decarboxylation; Fisher indole synthesis; aldol,

Bookshelf

EDITED BY R. K. GITLIN

Knoevenagel and other condensations; Cannizzaro and Wurtz-Fittig reactions; Pschorr phenanthrene synthesis; Diels-Alder reaction; polymerization and esterification.

Chapter IX, "Specific Methods of Oxidation, Reduction, and Halogenation," is a treatment of ozone, peracid, lead tetraacetate and periodic acid oxidations; lithium aluminum hydride, sodium borohydride and pinacol reductions; Wohl-Ziegler and sulfuryl chloride reactions.

To the chemical engineer who is solely concerned with practical methods for improving yields, this book wouldn't be particularly valuable. But it could be very helpful to anyone interested in the theory behind organic reactions and how an understanding of reaction mechanisms could be useful in choosing better conditions for certain procedures.

Inventors' "How To" Guide

How to FIND A BUYER FOR YOUR INVENTION. By V. D. Angerman. Science and Mechanics Publishing Co., Chicago. 186 pages. \$2.95.

If you're employed by a large company equipped with its own patent department, this book—except for its general informative content—is most probably not for you. You can no doubt get most of the information and leads that it supplies for potential inventors from the patent experts in your own firm.

If, on the other hand, you're an imaginative fellow (or gal) bursting with ideas that you think have commercial potential, but completely unfamiliar with the machinery involved in promoting said ideas, this handy little guide should set you on the right track.

Its basic aim is to provide the when, how and where of selling inventions. And it supplies this information in simple, step-wise form—how to:





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 Make use of government services in applying for inventions.

Perhaps the greatest single advantage of the book lies in its classified indices. Each firm listed has been classified, for the reader's convenience, in four ways—according to type of invention wanted, materials in which firms are prepared to work, type of equipment or processes available, facilities which firms can extend to you.

Though we wouldn't call this volume a reading "must," we do feel that it's worth more than a

passing glance,-BKG.

Streamlined Chemistry

PHYSICAL CHEMISTRY. By Neil Kensington Adam. Clarendon Press, Oxford. 670 pages. \$8.

Reviewed by F. C. Nachod

The well known British author and surface chemistry expert has summarized and extended his lecture course at Southampton University given in the past sixteen years and has come up with a highly streamlined and coherent text of physical chemistry primarily for the undergraduate curriculum.

The subject matter is treated in the classical manner. It encompasses the total of topics comprising the field, although the sequence varies slightly with

American usage.

Chapter V, covering quantum chemistry, deserves to be singled out for its lucidity in describing the basic approach to wave me-

chanics.

Engineers interested in unit cost calculations will find that the price of 1.21¢ per page of physico-chemical instruction isn't out of line with three recent American texts priced at 0.95, 1.06 and 1.11¢ per page, respectively.

Teachers of physical chemistry desiring a new, coherent text

will take a good look at Adam's fine work. Researchers in chemistry and chemical engineering will find this British import very useful in refreshing their memory in areas where they've lost close touch or where their own instruction and knowledge has been spotty.

Latest in Heterocyclic Series

ACRIDINES. By R. M. Acheson. Interscience Publishers, Inc., New York. 418 pages. \$12.50.

Reviewed by E. A. Steck

This monograph, Vol. IX in the series, "The Chemistry of Heterocyclic Compounds," represents an evaluation and appreciation of compounds containing the acridine ring system. Without becoming a mere catalog, it gives a wealth of information on many individual compounds in well arranged form.

The discussion of approaches to acridine types is handled as thoroughly as an experimentalist could. There's good balance in the aspects relating to synthesis, significance, properties and natural occurence of acridine derivatives.

Tinctorial and biological actions of acridines have been accorded clear and adequate discussion. Dr. L. E. Orgel has contributed a concise chapter on absorption spectra and related considerations.

It's significant that efforts to unify acridine nomenclature will doubtlessly be aided by this well documented volume. The British authors and American advisors should be well pleased with the typographical work done for them in the Netherlands.

BRIEFLY NOTED

LEAD DEPOSITS IN THE UPPER CAM-BRIAN OF CENTRAL TEXAS. 68 pages. By Virgil E. Barnes. Bureau of Economic Geology, University of Texas, Austin 12, Tex. Lead and zinc deposits in the Upper Cambrian rocks of central Texas are reviewed in light of new detailed information. Included are analytical data for all deposits, detailed stratigraphic



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sections of Cambrian rocks, maps at a scale of 4 in. to the mile.

EMBEZZLEMENT CONTROLS OF BUSI-NESS ENTERPRISES. 32 pages. By Lester A. Pratt. Fidelity and Deposit Co., 1864 Fidelity Build-ing, Baltimore 3, Md. Describes practical methods of combatting embezzlements of money, merchandise and other materials. Contains a check list for determining adequacy of a firm's embezzlement controls.

1955 VACUUM SYMPOSIUM TRANS-ACTIONS. 101 pages. \$10. Committee on Vacuum Techniques, Inc., Box 1282, Boston 9, Mass. Reprints of papers presented at Mellon Institute in October, 1955. Divided into four sections-fundamental development in vacuum technology, applications and processes, methods and techniques for obtaining high vacuum, standards and nomenclature.

THE ENGINEERING INDUSTRIES IN EUROPE. 207 pages. \$1.50. Organization for European Economic Co-Operation, 2000 P St. N. W., Washington 6, D. C. Report giving an account of economic trends and their principal causes in engineering industries of O.E.E.C. member-countries during 1952-1955. Discusses supply and demand of engineering products, international trade. Also includes statistical index of engineering products.

ASTM STANDARDS ON METALLIC ELECTRICAL CONDUCTORS. 298
pages. \$3.50. American Society
for Testing Materials, 1916 Race
St., Philadelphia 3, Pa. Cover copper, copper alloy, copper-covered steel—wire, stranded conductors, rods, bars, shapes, pipes, tubes; aluminum—wire, stranded conductors, rods and bars; galvanized steel core wire; galvanized iron and steel guy, messenger, span. ground, line wire.

SYMPOSIUM ON METALLIC MA-TERIALS FOR SERVICE AT TEM-PERATURES ABOVE 1,600 F. 193 pages. \$3. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Compilation of 14 papers covering, physical, chemical and mechanical properties of high-temperature alloys and cermets-e.g., nimonic alloys, Inconel 700, cobalt alloys, titanium-carbide products, etc.

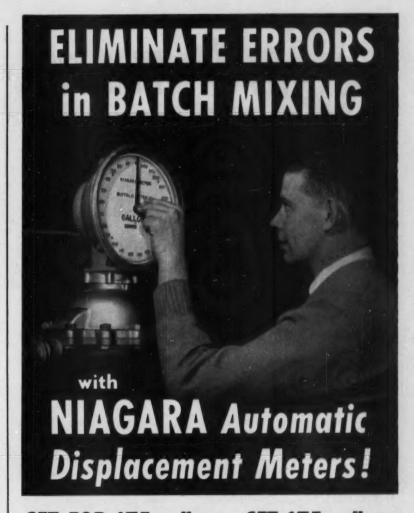
PROFESSIONAL CONSULTANTS' OPerations and Techniques. 46 pages. By C. C. Crawford. Industrial Department, Los Angeles Chamber of Commerce, Los Angeles, Calif. Report of the Business and Industrial Consultants Committee of the L. A. Chamber of Commerce. Covers six major areas—how to attract and find prospects for your services, how to sell your services to the prospect, how to serve the client, how to administer your consulting operations, how to advance the consulting profession, how to have good programs and meetings.

OBSERVATIONS ON THE PLANNED PROVISION OF NITROGEN FERTILIZER FOR THE WORLD. 45 pages. By J. Tinbergen, L. H. Klaasen, E. H. Mulder. Netherlands Economic Institute, Rotterdam, Holland. Covers measures to increase agricultural production, probable development of world demand for nitrogen fertilizers, investment plans and development of supply, planned provision of nitrogen fertilizers.

HANDBOOK OF WELDED CARBON STEEL TUBING. 267 pages. \$10. Formed Steel Tube Institute, Inc., 850-52 Hanna Building, Cleveland 15, Ohio. Presents facts on electric-resistance welded steel tubing, i.e., tubing formed from flat-rolled steel into tubular shape and welded into solid-wall tubing. Includes information on round tubing; square, rectangular and special shape tubing; propeller shaft tubing; carbon pressure tubing; mechnical properties; specifications; order information; fabrication, etc.

EMERGENCY AND DISASTER PLANNING FOR THE WATER AND SEWERAGE UTILITIES. 23 pages. 20¢. U. S. Dept. of Commerce, Washington 25, D. C. Highlights importance of restoring water and sewerage utilities following enemy attack upon American cities and towns of after natural disasters. Outlines measures to be taken as quickly as possible after disaster strikes.

APPLICATION OF PLASTICS TO ROLLER AND BALL BEARINGS. 115 pages. \$4.75. Department PB, Kaydon Engineering Corp., McCracken St., Muskegon, Mich. Report compiled specifically to obtain data for combat vehicle manufacture, but containing much valuable information for any company interested in plastic ball and roller bearings. Includes data on all plastics tested, testing procedures used, testing evaluations, charts showing merevaluations, charts showing mere



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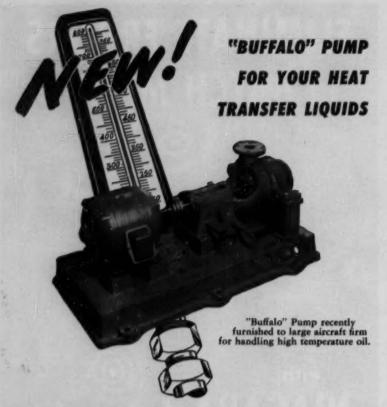
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ORGANOSILANES AND RELATED COMPOUNDS AS HIGH-TEMPERATURE
LUBRICANTS. PART I.—SYNTHESIS AND PROPERTIES OF DODECYLTEHALKYLSILANES. 22 pages. 75¢.
By H. Rosenberg, et al. Order
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Commerce, Washington 25, D. C.
Introductory study of synthesis
and properties of dodecyltrialkylsilanes. Certain physical properties correlated with molecular
structure. On basis of preliminary evaluation, compounds seem
to have promise as base stocks
for certain extreme temperature
and lubricant applications.

HISTORY OF INDUSTRIAL HYGIENE FOUNDATION. 19 pages. Industrial Hygiene Foundation of America, Inc., Mellon Institute, 4400 Fifth Ave., Pitteburgh 13, Pa. Story of the development and growth of the foundation, now celebrating its 20th year of service to industry in the field of occupational health problems.

TEN YEAR INDEX TO CORROSION 1945-1954. 32 pages \$5 (NACE members), \$7.50 (non-members). National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas. Contains alphabetical subject index of about 4,000 reference phrases and alphabetical author index of 1,056 names. Titles of 629 articles published in the first decade of publication (1945-1954) of Corrosion, monthly NACE journal, are included.

A STUDY OF PLASTIC PIPE FOR POTABLE WATER SUPPLIES. 90 pages. \$1. National Sanitation Foundation, School of Public Health, University of Michigan, Ann Arbor, Michigan. Report on project sponsored by the Society of the Plastics Industry for its Thermoplastic Pipe Division and for suppliers of plastic materials. Details studies, extending over a three-year period, made of 22 samples of plastic pipe to determine their suitability for underground use in conducting cold potable water.

Investigation of the Effect of Raw Material Production Variables on the Physical and Chemical Properties of Carbides, Nitrides and Borides. 105 pages. \$2.75. By H. Blumenthal. Office of Technical Services, U. S.

Dept. of Commerce, Washington 25, D. C. Five-part report dealing mainly with titanium carbide. First section is a study of as-received titanium carbide; second deals with hot pressing of unbonded carbide bars; third with infiltration of titanium carbide skeltons; fourth with effect of various impurities; fifth with microstructures of titanium carbide bars produced in different ways and evaluation of structures in light of physical performance of respective bars.

MORE NEW BOOKS

ADVANCES IN CHEMICAL ENGINEER-ING. Vol. 1. Edited by T. B. Drew and J. W. Hoopes, Jr. Academic Press. \$10.

ATOMS AND ENERGY. By H. S. W. Massey. Philosophical Library. \$4.75.

CATALYSIS. Vol. 4. Edited by P. H. Emmett. Reinhold. \$12.50.

CHEMISTRY AND USES OF PESTI-CIDES. 2nd ed. E. R. deOng. Reinhold. \$8.75. Chromium. Vol. 1. Edited by M. J.

Udy. Reinhold. \$11.

CURRENTS IN BIOCHEMICAL RE-SEARCH 1956. Edited by D. E. Green. Interscience. \$10.

DIE WISSENSCHAFTLICHEN GRUND-LAGEN DER TROCKNUNGSTECHNIK. By O. Krischer. Springer-Verlag. DM 46.50.

ELECTRICAL INTERFERENCE. A. P. Hale. Philosophical Li-

brary. \$4.75. GLASS. By G. O. Jones. Wiley. \$2. GMELINS HANDBUCH DER ANOR-GANISCHEN CHEMIE. 8. Auflage. CALCIUM. Part B1. \$34.99 KUP-FER. Part A1. \$92.13. KUPFER.
Part A2. \$101.98. THORIUM UND
ISOTOPE. \$55.68. Verlag Chemie.
HISTORICAL BACKGROUND OF CHEM-

ISTRY. By H. M. Leicester. Wiley \$6.

MICRORECORDING. By C. M. Lewis and W. H. Offenhauser, Jr. Interscience. \$8.50.

NUCLEAR FUELS. Edited by D. H. Gurinsky and G. J. Dienes. Van Nostrand. \$7.50.

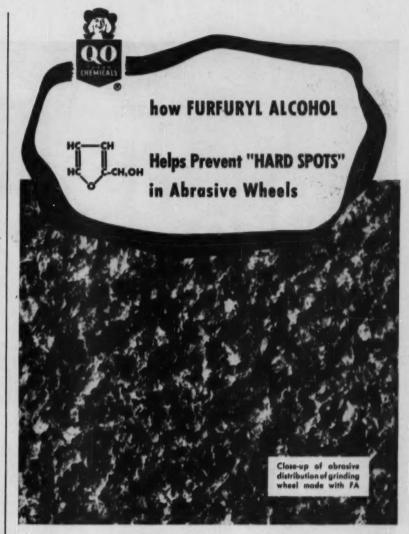
PHYSICS AND MATHEMATICS. Vol. 1. Edited by R. A. Charpie, J. Horowitz, D. J. Hughes and D. J. Littler. McGraw-Hill. \$12.

WELDING. RESISTANCE American Welding Society. Reinhold. \$4.50.

SODIUM. By M. Sittig. Reinhold. \$12.50.

STRUCTURE OF TURBULENT SHEAR FLOW. By A. A. Townsend. Cambridge University Press. \$7.50.

SYNTHETIC METHODS OF ORGANIC CHEMISTRY. Vol. 10. By Theilheimer. Interscience. \$25.25.



As a solvent, aids uniform distribution of abrasive mix

Gives superior cold flow during molding cycle

Reacts with resin during cure for maximum hardness

Highly active, yet easily controlled, QO Furfuryl Alcohol both dissolves and reacts with phenolic resins. As such, FA becomes an integral part of the final bond. It assures good curing and easier manufacture of uniformly hard resinoid wheels and other abrasives.

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"Is this that Pritchard Hydryer you've been raving about, Ben?"

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"You bet I am. Remember those few months before we got our Hydryer? Those nights and weekends we had to work trying to keep all those precision instruments operating. If it wasn't moisture that was fouling things up, it was corrosion."

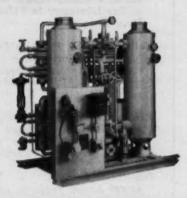
"I remember only too well. Say, Ben, how did you get a line on that Pritchard Hydryer in the first place?" "I sent for a copy of their bulletin on the Hydryer. After I read it I talked it over with the chief and we ordered ours. You know this unit does everything their literature said it would. Right now we're pulling 63 pounds of water from our instrument air every day. It dries 160 SCFM at 100-psig., and 90°F."

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COOLING TOWERS . GAS & AIR TREATING EQUIPMENT REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST THIS MONTH'S

Firms in the News

EDITED BY F. ARNE

New Locations

Kerr-McGee Oil Industries, Inc., has moved the Kansas City, Mo., office of its Deep Rock division to 906 Grand Ave.

Chapman Chemical Co. has moved its home office into its own building at 60 North Third St., Memphis, Tenn.

St. Regis Paper Co. has moved its headquarters to 150 East 42nd St., New York.

Flodar Corp., Cleveland hydraulic fittings and tube manufacturer, has moved to larger quarters at 16911 St. Clair Ave.

LaMotte Chemical Products Co.
has moved its operations to a
new plant at Chestertown,
Md.

Roger Williams Technical & Economic Services, Inc. has moved to P. O. Box 426, Princeton, N. J. The company has retained its office in New York.

Ninol Laboratories, Chicago, has transferred its research and development laboratories to its new plant at Prudential Plaza.

New Names

Safety Car Heating & Lighting Co., New Haven, Conn., has changed its name to Safety Industries, Inc.

James-Pond-Clark, Pasadena, Calif., has announced a new company name and a new company division. Circle Seal Products Co. will handle industrial sales of precision valves; James, Pond and Clark has been organized for the sale of circle valves to aircraft and other military customers.

General Electric Co. has changed the name of its Carboloy department to the metallurgical products department.

George S. Truskey, Inc., Philadelphia, has changed its name to Truskey Industrial Pipefitters, Inc., and has expanded its construction and engineering services to include industrial air conditioning, process piping, ventilating systems and waste disposal and water treatment work.

Penberthy Injector Co., Detroit, has changed its name to Penberthy Mfg. Co. to better identify its operations.

Joseph T. Ryerson & Son has changed the name of its Ryertex-Glyco division to the industrial plastics and bearings division.

New Facilities

National Sugar Refining Co. has bought the sugar refining business of Godchaux Sugars, Inc.

Jalco, Inc., Dallas, has acquired a 53% interest in Westpan Hydrocarbon Co. from Sinclair Oil Corp. Westpan, with headquarters in Amarillo, Tex., has various interests in the production of liquid hydrocarbons and natural gas and crude oil.

American Zinc Institute has commissioned Battelle Memorial Institute to undertake a research project covering new and improved finishes for zinc die castings.

Gulton Industries, Metuchen, N. J., is putting up a new building to provide additional space for research, engineering and testing in such fields as ultrasonics.

Pulpwood Development Co., consisting of a group of Memphis and Lauderdale County, Tenn., businessmen plan to develop a \$35-million pulp

Pumping Progress Report

FOR CHEMICAL ENGINEERS

An advertisement prepared by the Aldrich Pump Co. Member of Hydraulic Institute, U.S.A.

- UREA PRODUCTION, like many other chemical processes,
 presents difficult pumping problems. Urea
 slurry is both corrosive and erosive. Either
 condition can cause serious operational headaches; together they spell trouble for both
 design and maintenance engineers.
- PUMPING UREA SLURRY was the problem given to the

 Aldrich Pump Company Engineers by one of the
 foremost producers of urea. Our solution was
 effective. We recommended...
- A 6" STROKE DIRECT FLOW TRIPLEX with several material of construction modifications. Porcelain plungers were used instead of the usual hardened alloy steel. The entire fluid-end was made of Hastelloy B, but Direct Flow Fluid-End construction was maintained to give minimum cost of parts replacement in the event of unavoidable corrosion or erosion damage.
- ALDRICH DIRECT FLOW DESIGN offers many advantages to reciprocating pump users. Two right angle turns are eliminated in the fluid-end block. The liquid being pumped travels in a straight line, on a horizontal plane, from the suction to the discharge manifold. Reduced space between valves results in higher volumetric efficiency and extra close valve clearance.
- SECTIONALIZED FLUID-ENDS also afford greater economies of maintenance. Valves can be removed for inspection or replacement without special tools or equipment. Individual sections of the fluid-end can be replaced at a fraction of the cost of conventional type fluid-ends.
- DATA SHEET 67A illustrates and describes the Aldrich
 6" Stroke Direct Flow Pump Series. This
 Series includes Triplex, Quintuplex, Septuplex
 and Nonuplex Pumps, ranging in power from 300
 to 900 hp. Aldrich Engineers are available
 to help you solve your tough pumping problems.
 Address your request to: The Aldrich Pump
 Company, Gordon Street, Allentown, Pa.

FIRMS . . .

- and paper plant at Fulton in Lauderdale County on a site once considered for a TVA steam plant.
- Laclede-Christy Co. has installed a quality control clay testing laboratory in Fulton, Mo.
- National Starch Products Inc. has doubled production capacity of polyvinyl acetate polymers at its new Meredosia, Ill., plant.
- Panama Refining and Petrochemical Co. S. A. plans to build a 55,000-bbl./day refinery near Colon, Panama.
- Interchemical Corp. has acquired Angier Products, Inc., Cambridge, Mass., manufacturers of industrial adhesives
- Graver Water Conditioning Co., New York, has opened a new sales-service office in Boston.
- Chinese Petroleum Corp. has started up new units at its refinery in Taiwan which will now be able to supply all of the island's high-octane motor gasoline and jet fuel needs.
- Lake Charles Chemical Corp.
 has started a \$6.25-million
 project to add a 10,000 bbl/
 day delayed coker and calcining unit to its Lake Charles,
 La., refinery.
- American Mineral Spirits Co., Chicago, has opened a new Baltimore sales office and solvents and chemicals terminal.
- Fuller .Co., Catasauqua, Pa., manufacturer of pneumatic materials handling equipment, has opened an office in Kansas City., Mo.
- Society of the Plastics Industry has formed a vinyl dispersions division.
- M. W. Kellogg Co., Jersey City, N. J., has contracted with Rensselaer Polytechnic Institute for a program of research in the hot ductility of alloy steels.

Shallway Corp., Connellsville, Pa., manufacturer of shell molding and shell core blowing equipment, has opened a European office in Duesseldorf, Germany, for its sales and service company, Shallway International Corp.

Magnolia Petroleum Co., Dallas, has bought a 2-million-volt Van de Graaf particle accelerator for nuclear research on petroleum.

Water Service Laboratories, Inc., has opened an annex to its New York facilities which will provide more space for manufacturing and packaging water-treating chemicals.

Hills-McCanna Co., Chicago, manufacturers of diaphragm valves, metering and proportioning pumps, has opened a Phildelphia sales office.

Southern Pine Lumber Co. plans to complete a \$4-million fiber board plant in Didoll, Tex., in the fall of 1957.

Dow Chemical Co. plans to build a new administrative center for the entire company at Midland, Mich.

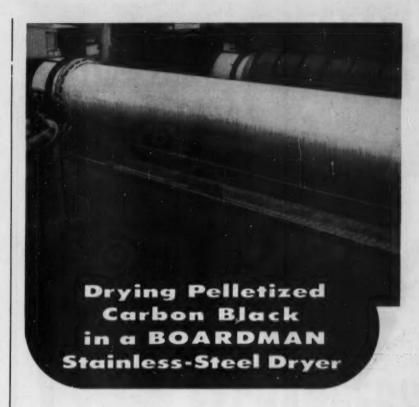
Air Pollution Control District has been allotted \$1.1 million by the Los Angeles County Board of Supervisors for construction of a permanent headquarters building in 1956-57.

Allegheny Ludlum Steel Corp. has started up a new induction vacuum melting facility at its Watervliet, N. Y., plant.

Synthetic Mica Corp., Caldwell Township, N. J., has doubled the size of its research and development facilities.

Westinghouse Electric Corp. has started construction of an additional wing to its new research laboratories near Pittsburgh, Pa.

Pennsylvania Color & Chemical Co. plans a new unit at its Doylestown, Pa., plant which will add 20% to its output of pigment dispersions in vinyl

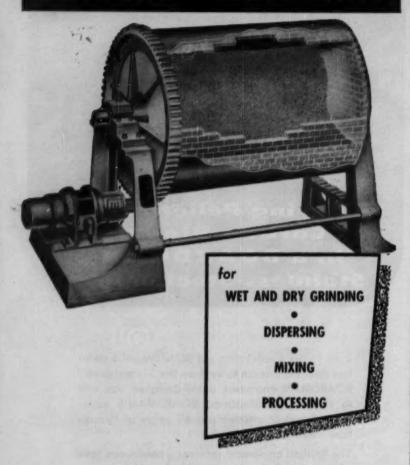


J. M. Huber Corporation put BOARDMAN'S stainless steel experience to work on this 51-foot dryer. BOARDMAN engineers detail-designed this unit to Huber's specifications; BOARDMAN'S experienced metalcraftsmen put 45 years of "know-how" into its fabrication.

The finished equipment receives a continuous feed of moist, pelletized carbon black, which in progressing through the dryer, emerges as dry pellets—a dustless, dense, easily handled and shipped product. Your process may call for this same principle of indirect drying—or perhaps direct fired equipment meets your plans best. Regardless of the process, BOARDMAN would like the opportunity of discussing your metalcrafting problems with you.



ABBÉ Engineering Ball and Pebble Mills



ABBÉ Engineering Ball and Pebble Mills are available in capacities from 30 lbs. (dry), 5 gal. (wet), to 14,000 lbs. (dry), 2500 gal. (wet).

It will pay you to investigate these, as well as Abbé Jar Mills and Jar Rolling Machines, which cover every need and capacity.

Write for Catalogs 73 and 77 and complete data.



ABBE ENGINEERING COMPANY 50 Church Street, New York 7, N.Y. FIRMS . . .

resins and of transparents for foil and metal coatings. New unit is due on stream during first quarter, 1957.

Hart Products Corp., manufacturers of textile, leather and industrial chemicals, has opened a new research and development laboratory in Jersey City, N. J.

Technical Developments Associates, Inc., Cleveland chemical consulting firm, has opened a West Coast branch office in San Francisco.

Salt Lake Pipe Line Co. has started a \$1-million expansion at its Boise terminus to increase capacity of its Salt Lake-Spokane products line. Some 370,000 bbl. in additional tankage is involved.

Enjay Co. has established a new central sales division with headquarters at Chicago.

Air Reduction Sales Co. has doubled its capacity for production of industrial gases at Butler. Pa.

Lindberg Steel Treating Co., Chicago, has started expansion of its Melrose Park, Ill., plant which will provide a 60% increase in productive capacity. Products include induction heating equipment, furnaces using hydrogen, nitrogen and inert gases for heat treatment of super-alloys.

Thomas A. Edison, Inc., West Orange, N. J., has acquired the Glenbrook Chemical Co., New Haven, Conn., for its medical gas division.

Du Pont Co. is adding facilities to its Circleville, Ohio, plant for coating Mylar polyester film to permit wider application in packaging and industrial fields.

Lehigh Portland Cement Co. has bought a \$20-million cement manufacturing plant near Miami.

Wilson & Co. plans additions to its Chicago operation by the end of the year which will include a new push-button rendering plant and other facilities for utilizing both the edible and inedible waste from live stock.

Texas Gulf Sulphur Co. will soon begin mining sulfur at a new location in Mexico on the Isthmus of Tehuantepec.

Olin Mathieson Chemical Corp.
is discontinuing manufacture
of ammunition at its New
Haven, Conn., plant and will
consolidate all such operations in East Alton, Ill.

Cadar Paint Corp. has completed a new plant in Baltimore.

Kordite Co., division of Textron American, Inc., plans to build a \$50,000 plant in Monticello, Ill.

Meer Corp., manufacturers of botanical drugs, gums and spices, has started building a plant in North Bergen, N. J.

National Lead Co. has acquired a substantial interest in Baritina de Venezuela, S. A., a distributor of oil well drilling materials in Venezuela since 1949.

Farbenfabriken Bayer AG of Leverkusen, Germany, has perfected a proces for cracking oil and oil fractions and turning them into gaseous olefins, notably ethylene. The company will build such a cracking plant at its Dormagen works.

Rietz Mfg. Co., Santa Rosa, Calif., manufacturer of process equipment, is building a fully equipped eastern headquarters at West Chester, Pa.

Imperial Oil Co., Vancouver, B. C., plans to spend \$4 million for a special 5,000-bbl./ day catalytic powerformer, prefractionator and hydrofiner.

Union Carbide & Carbon Corp. will start construction of four buildings in Tarrytown, N. Y., in 1957 to house the sales de-



Keep an eye on Tramp Metal Trouble with DINGS

ETAL DETECTORS

With a Dings Metal Detector "eye-ing" your product, you stop tramp metal trouble before it starts. Tramp metal particles can't pass it netal trouble before it starts. Tramp metal particles can't pass it unseen to impair product quality—no monkey wrench in the machinery can cause costly damage. Whether your product is in raw or finished condition, in bulk or pressed form, liquid or viscous, granular or fibrous, or in deep, heavy burdens, there's a type of Dings Metal Detector to scan the material constantly, sound the alarm or stop the belt at the first sign of tramp metal.

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- Rubber-mounted water-tight Search
- · Control relay inside cubinet
- · Low power consumption

Dings low-cost Universal Series Metal Detectors signal the presence of all magnetic minerals which pass through the Detector Search Coil.

Extremely simple in design, installation and operation, Universal Series Detectors require practically no attention. Just place the Search Coil around the belt, plug into any single phase outlet, and turn on the switch . . . and you have constant, automatic protection against tramp metal damage at extremely low cost.

FOR DEEP BURDEN SERVICE in mining and other heavy industries -... DINGS ELECTRONIC METAL DETECTOR.

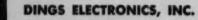
Dings EMD units detect the presence of any metal, ferrous or non-ferrous, signal the presence of even minute particles to assure tramp metal protection that magnetic detectors and separators can't provide. Dings Electronic Metal Detectors pay for themselves by preventing damage wherever tramp metal is a problem.



REDESIGNED CONTROL CABINET

Newly designed control cabinet features a double hinge arrangement to provide the utmost accessi-bility to all parts. The electronic circuit is sim-pler, assuring easier installation and even greater stability. Most important, the new design in-creases sensitivity considerably.

WRITE FOR FULL INFORMATION



(Subsidiary of DINGS MAGNETIC SEPARATOR CO.)

4730 W. Electric Ave. Milwaukee 46, Wisconsin

FIRMS . . .

partments of several of the company's divisions, a basic research laboratory, a central utilities building.

McDanel Refractory Porcelain Co., Beaver Falls, Pa., has just completed a \$125,000 expansion of its production facilities.

Aceto Chemical Co., Flushing. N. Y., has opened a West Coast office in North Hollywood, Calif.

Clorox Chemical Co. has started up a new plant in Boston.

Davison Chemical Co., division of W. R. Grace & Co. has opened a San Francisco office.

Celanese Corp. of America will build a 3-million-lb./yr. acetate yarn plant near Valparaiso, Chile, for its sub-sidiary, Celatino, S. A.

Shell Chemical Corp. has started construction on an addition to its technical service laboratory in Union, N. J.

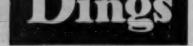
Shell-Saint Gobain will build two petrochemical plants in the Berre, France, area. These will produce alkylates used for powder detergents and olefins used for making "oxo" alcohols.

Esso Nederland N. V. will complete a \$29-million refinery in Rotterdam, Holland, by 1960

Hess Products Ltd., British subsidiary of Armour in Chicago, recently opened a new fully automatic chemical plant at Littleborough in Lancashire, England, for the production of nitrile derivatives of fatty acids.

Permacel Tape Corp., New Brunswick, N. J., has purchased LePage's, Inc., Gloucester, Mass., manufactuer of glues, pastes, mucilage and adhesives.

Standard of Indiana has completed installation of its Whiting Refinery's first Ultra-



former, a 14.000-bbl./day unit and plans to install a second. of 21,000 bbl./day capacity.

Texas Gas Corp. has started a program aimed toward recovery of many petrochemicals from its immense gas reserves on the Texas Gulf

Stauffer Chemical Co. has purchased a half interest in the phosphate rock mining operations of the San Francisco Chemical Co. in southeastern Idaho and southwestern Wyo-

Chas. Pfizer & Co. plans to build a plant in Latina, Italy, to produce pharmaceutical veterinary drugs and anima! feed supplements.

Henry Bower Mfg. Co., Philadelphia, plans a new cuprous chloride plant for high purity product.

Britain's National Coal Board and Central Electricity Authority have accepted responsibility for the planning and construction of a pilot plant for the underground gasification of coal. Site is undecided as yet.

Brown Co., New England pulp and paper producer, has purchased the bituminous fiber pipe manufacturing plant of Blacfiber Pipe Co. in Carvallis, Ore.

Koppers Co. has bought land near Monroeville, Pa., as the site for a multi-million dollar research center.

Atomic Energy Commission has contracted with Battelle Institute for critical assembly studies of a small heterogeneous boiling water reactor for military application.

Reilly Tar & Chemical Corp. has completed new facilities for 2, 6-diaminopyridine at its Indianapolis, Ind., plant.

Dresser Industries, Dallas, Tex., has joined forces with New York Shipbuilding Corp., Camden, N. J., for packaged pro-



les Offices: Birmingham, 1727 Sixth Ave. North; Chicago, 5807 W. versey: Pittsburgh, Union Trust Building; Heuston, 1213 Capitale e. • West Coest: Star Wire Screen & Iron Works, Inc., 2515 Sen rnando Ré., Los Angeles Subsidiary, Ludiow-Saylor Wire Cleft Cc.

As pioneers in the filter press field, and one of the oldest and foremost manufacturers of filtration equipment, D. R. SPERRY & CO. is well qualified to evaluate your specific filtration requirements.

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All types . . . all sizes. Plain or punched to your specifications. Besides cotton and paper, bases are furnished in wool, synthetics, glass and woven metals.

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New Handraulic Clesing Device





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BATAVIA, ILLINOIS

FIRMS . . .

duction of specialized ships urgently needed by the nation's offshore oil industry.

Dorr-Oliver Inc. plans a \$900,-000 expansion program for its manufacturing plant at Hazleton, Pa.

General Dynamics Corp. has leased a temporary laboratory in San Diego, Calif., for its Convair division. Facilities include a 200-sq.-ft. chemical laboratory.

Imperial Chemical Industries Ltd. has started up in Melbourne, Australia, a plant for continuous processing of nitroglycerine, said to be the largest of its kind in the world.

Aluminum Ltd. plans a second alumina manufacturing plant on the island of Jamaica to utilize local bauxite ores and keep pace with expanding primary aluminum capacity in Canada. The \$35-million unit will start producing 245,000 tons/yr. by mid 1958.

Dayton Rubber Co. has started operating a giant machine, capable of producing 8 million lb./yr. of polyurethane, at its Marietta, Ohio, plant.

Turco Products, Inc., Los Angeles, has established a complete pilot line for the chemical milling of steel and titanium in a joint research and development effort with North American Aviation, Inc.

Gas and Fuel Corp. will start producing high-grade gasoline this fall at a Lurgi brown coal gas project at Morwell, Australia.

New Lines

Continental Can Co., New York, now has a line of shipping containers and cartons as a result of its merger with Robert Gair Co. Continental has also recently acquired Canadian Crown Cork Co. Ltd.

Superior Tube Co., Norristown, Pa., formally entered the atomic energy industry with the creation of a nuclear products division for the fabrication of sub-assemblies and components used in the core of nuclear power reactors.

New Representatives

Alkydol Laboratories, Inc., Cicero, Ill., has appointed Pacific Coast Chemicals Co., with offices in Berkeley and Los Angeles, Calif., Portland, Ore., and Seattle, Wash., as its West Coast representative.

Lehigh Chemical Co., Chestertown, Md., lubricants manufacturers, have appointed two new sales agents: Ray Aircraft Supply Co., Dallas; Wilco, Inc., Wichita, Kan.

Carboline Co., St. Louis, Mo., has appointed Specialty Supply Co., Mobile, Ala., to handle protective coating sales and servicing in Alabama and Mississippi.

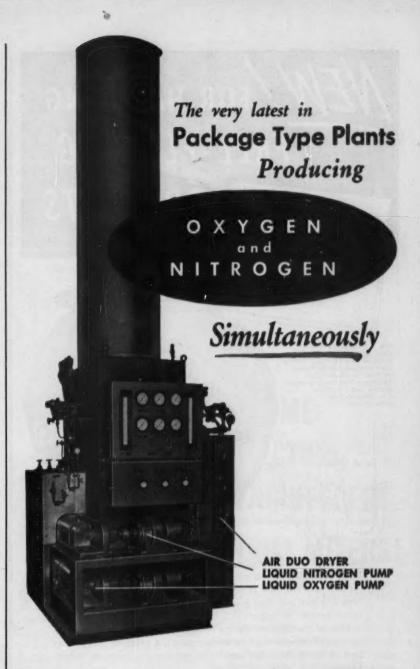
Dickey Industries, Cleveland, has appointed L. P. Best Co. as Washington, D. C., representative for two of its affiliates: Ohio Hoist & Mfg. Co., Lisbon, Ohio, manufacturer of materials handling equipment; Alcaloy, Inc., special alloy metals manufacturer of Trenton, N. J.

Conoflow Corp., Philadelphia, has appointed Chemical & Industrial Sales, Ltd., Edmonton, as sales-engineering representative in Alberta and Saskatchewan.

Automatic Switch Co., Orange, N. J., has appointed Hydraulic Equipment Co., Los Angeles, as stocking distributors of its solenoid valves.

Schutte and Koerting Co., Cornwells Heights, Pa., has appointed Wayne Wiscomb Co., Salt Lake City, Utah, sales representative for Utah and sections of Wyoming, Idaho and Nevada.

Reynolds Metals Co., Louisville, Ky., has appointed Joseph T. Ryerson & Son, Chicago, to sell its aluminum throughout the areas served by Rey-



With the introduction of our latest, improved design Package Type Generating Plants, production of high purity Oxygen and Nitrogen simultaneously increases production 60% over the production of Oxygen alone, plus a corresponding reduction in the cost of manufacture. Due to its compact design, a minimum of floor space is required and streamlined panel assembly insures instant visibility of all control gauges. Stock sizes from 1500 to 10,000 cu. ft. per hour. Larger and smaller sizes available. 99.99% Argon available on large size plants.

We invite your inquiry.



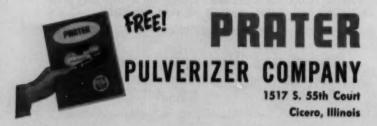


No matter how attritionized the product, this new Prater Blow-Thru Feeder will feed it efficiently and quickly into any pneumatic system. And this new design becomes an integrated part of the pipe line and will feed against pressures as high as 10 PSIG... either positive or negative!

One of the efficient design features of this unit is that on the horizontal center line of the body casing is a pressure neutralizing port to bring the rotor pockets to atmospheric pressure before filling.

There are many other interesting and high quality production features. Power requirements vary according to the fineness and abrasiveness of the product . . . flour, salt, carbon or any other material.

Available in cast iron and bronze . . . write today. Ask for our new airlock catalog, the most comprehensive in the industry!



FIRMS . . .

nolds' Chicago and Milwaukee plants.

Dorr-Oliver Inc. has appointed Equipment Engineers, Inc., Wynnewood, Pa., as its exclusive representative for industrial pumps in eastern Pennsylvania, northern Delaware and southern New Jersey.

Allied Chemical International Corp., New York, has appointed Canada Colors and Chemicals, Ltd., Toronto, as its distributor for polyethylene in Ontario, Quebec and the Maritime Provinces.

New Companies

Coatings and Fiberglass Research Co. has been formed in Los Angeles to offer specialized consulting service for paint and plastic manufacturers and users.

Huss Ontonagon Pulp and Paper Co., whose ownership is affiliated with the Huss Lumber Co. of Chicago, has been formed. The new company has bought the Ontonagon, Mich., pulp and paper mill of the National Container Corp. and will convert it from a kraft liner board cylinder mill to a neutral sulfite semichemical board mill manufacturing corrugated medium.

Habib-General Ltd. of Karachi has been formed to build and operate a guar gum plant in Kaarchi, Pakistan. Co-owners are General Mills, Inc., and Habib-General Ltd. of Pakistan

Walmet Corp., Madison Heights, Mich., has been formed to produce special grades of carbide blanks and shapes for use in metal cutting, forming, woodworking and wear resistance applications.

Societe Francaise des Industries Dresser, S. A., a French subsidiary of Dresser Industries, Inc., Dallas, Tex., has been formed to represent several of the Dresser industries in France and to provide technical services to the Dresser companies operating on the continent. Calumet & Hecla of Canada, Ltd., with headquarters in London, Ont., has been formed as a wholly-owned subsidiary of Calumet & Hecla, Chicago.

American Industrial Models, a subsidiary of Industrial Models, Inc. of Wilmington, Del., has been formed at Manchester, England.

Soybean Council of America has just been formed in Hudson, Iowa, to promote both domestic and export markets for soybean products and soybeans. Founding organizations are the American Soybean Assn. and the National Soybean Processors Assn.

Dean-Cardox Chemicals Corp.
has been formed by Dean
Chemicals, Inc., Detroit, and
Cardox Corp., Chicago, which
have combined their Detroit
dry ice and liquid carbon dioxide operations.

Warren Mfg. Corp., Warren, Pa., has been formed for the production of new automotive products used in freight, petroleum and chemical hauling.

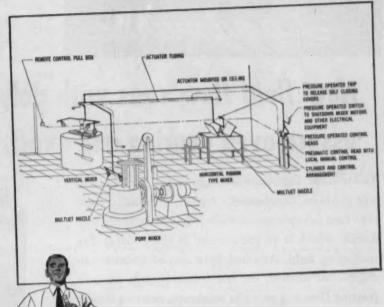
Reynolds Haitian Mines, Inc., has been formed to conduct mining operations in Haiti to supply bauxite for Reynolds Metals Co.

Scanlan-McMahon Associates, a new firm of consulting engineers, has been established in Cleveland.

Orogil, a company to produce and sell greasing oil additives in France, has been formed by the French chemical company, Progil, and Oronite Chemical Co.

Pharmco, Inc., Cleveland, has been organized to serve the private formula trade in pharmaceuticals, cosmetics and the chemical specialties field.

Bell Automation Corp., Rochester, N. Y., has been formed by Bell Aircraft Corp. to specialize in the field of automatic controls and systems.



FULL-TIME FIRE PROTECTION... CUSTOM-ENGINEERED OR INDUSTRIAL MIXERS!

SPECIAL HAZARDS—like industrial mixing vats shown in the diagram above — deserve special fire protection . . . the custom-engineered kind of fire defense that you get with a Kidde ${\rm CO}_2$ Fire Extinguishing System!

Fully automatic, the Kidde system provides 'round-the-clock protection... insures full-time security even in case of outside power failures. Rate-of-temperature-rise detectors spot the first sign of flame, and cause Multijet nozzles to discharge fire-smothering carbon dioxide that stifles the blaze in seconds. At the same time, the Kidde system

switches off fans and machinery and sounds an alarm.

All moving parts of a Kidde system are self-enclosed to prevent accidental discharge. Easy-to-read visual indicators show at a glance whether the system is "set" or "released." And Kidde Directional Valves let you guard more than one hazard from the same cylinder bank, providing completely versatile fire protection.

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Kidde



Walter Kidde & Company, Inc. 928 Main Street, Belleville 9, N. J.

Walter Kidde & Company of Canada Ltd., Mentreal—Terento

Landmarks

Periodic progress reports of interest and value to the chemical field

New fluid flow cans with polyethylene nozzle assure even pouring and exact, dripless cut-off

Tailor-made for liquid detergents and other corrosive products, Continental's recently-announced fluid flow cans incorporate a threaded, dripless polyethylene nozzle which is an innovation in the general line packaging field. Attached by a special Continental-engineered method, the tall nozzle permits an even pouring flow and provides an abrupt, exacting cut-off when pour is completed.

New enamel linings perfected by Continental's Research and Development department make these cans ideal for many products which could not be previously packaged in metal. In addition, a resistant varnish is available to prevent any marring of the lithographed surface through spillage in filling or use.

No solder is used anywhere in the construction. The side seam is cemented with thermo-plastic cement which permits complete wrap-around lithography. Can domes or tops can be supplied plain, coated, or lithographed in colors. Nozzles come in colors to closely match decorative designs. Manufactured in 12-, 16-, 22-, 32-oz. and half-gallon sizes.

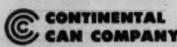


Threaded polyethylene nozzie is dripless. Attached by solderless method — no solder margin to steal from lithographed area.



BACK VIEW

Side seam is securely cemented, permitting complete wap-around decoration. No wide soldered seam to interrupt your selling mexisge.



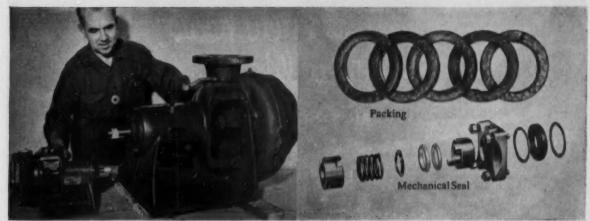
EASTERN DIVISION: 100 E. 43nd St., New York 17 CENTRAL DIVISION: 135 So. to Sallo St., Chicago 3 PACEPIC DIVISION: Russ Suilding, Son Francisco 4





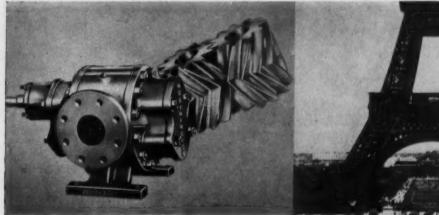
WHAT'S YOUR P.Q

PUMP QUOTIENT



Pump standardization-how do you benefit? By standardizing, you can often drastically cut your spare parts inventory. With Worthington's SESC (Standard End Suction Centrifugal) line, you are also assured of immediate delivery from factory or distributor stocks. Because the SESC line consists of standardized "parts" not "pumps," it can be built in many different combinations . . . 70,480 to be exact. For all these reasons, more and more companies are turning to SESC pumps. See bulletin W-300-B4.

Packed stuffing box or mechanical seal-which is preforred? Each has its applications. Mechanical seals are gaining in popularity year after year. With Worthington's Standard End Suction Centrifugal pumps you not only get your choice of mechanical seals-or packing-but you can easily convert from one to the other using standard stock parts. This "interchangeability" is just one of the many extra advantages of Worthington's SESC line. For more details write for bulletins W-300-B4 and W-350-B16.



Which pump is best for difficult suction conditions? Worthington's close-clearance rotary pump is self-priming and can operate under vacuums as high as 28 inches of mercury. The large unobstructed suction opening in this herringbone gear pump permits operation with thin or viscous liquids at high efficiency. The double-helical gears balance all end thrust, eliminate trapping of liquid between gear teeth and provide a quiet, pulsation-free flow at high speeds. For the full story, ask for bulletin W-483-B2.



Whose pumps would you expect to find in the Eiffel Tower? If you said "Worthington's," your P.Q. is all right. The original steam-driven pumps that power the Eiffel Tower's 100-passenger hydraulic elevators were built by Worthington back in 1889. The most recent additions, modern electric-drive Worthington pumps, moved into the Tower just last year. Today as then, wherever men must move liquid, they turn to the company with a reputation for performance. Worthington Corp., Harrison, N. J. 90. 0.0

WORTHINGTON



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This hard, dense thermoplastic offers a combination of properties unobtainable in any other material. It is readily moldable. It has extreme resistance to chemical attack, heat and cold. It possesses excellent dielectric properties.

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ever, is the time to investigate KEL-F Plastic. Perhaps it can help you create better products, meet higher performance specifications, or prolong equipment life.

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For further information and a list of the new prices for KEL-F molding powders, write: The M. W. Kellogg Company, Chemical Manufacturing Division, P. O. Box 469, Jersey City 3, N. J.



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Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.-America's largest producer of salt



Unloading Bulk Salt From Boxcars—at Lower Cost

While salt is a relatively low-cost material, handling it often involves considerable expense in time and manpower. Unloading bulk salt from boxcars, for example, has always been one of the problem spots. Today, however, a number of money-saving unloading methods have been developed for large and small plants.

Determining which of these modern salt unloading methods is best for your company depends on the tonnage involved, and specific plant requirements. But you can generally find one which will pay for itself—in savings on time and labor—over a relatively short period. Here is a review of four practical salt unloading methods, and the equipment used in each.

Portable conveyor system. This is the simplest improvement over straight manpower. A power-operated belt conveyor of



suitable length is placed inside the car door, and salt is then shoveled onto it. Conveyors may be used to bring salt directly into the plant—or even to storage areas above dock level. A good

conveyor for most needs is generally about 16 to 18 feet long and capable of moving salt up a 30° slope. With a conveyor, a good deal of manpower in shoveling is required, but one 40-ton car can be unloaded in about 12 to 14 man-hours—a 19% saving in time over straight manpower.

Scoop truck and conveyor. A scoop truck is simply an enlarged scoop shovel with two small wheels at the bowl of the scoop. Whereas a shovel holds only about 20 lb. of salt—a scoop truck holds 100 to 150 lb. In operation, the scoop is pushed into the

salt, tilted up, and then wheeled to the conveyor at the car door. With just one of these scoops, a worker can unload 40 tons of salt in 10 hours—and once the job is under way, there is room for two



or three more men with scoops. An

important point: A good scoop truck costs only about \$50.

Automatic power shoveling. This is one of today's most popular methods for unloading bulk salt—and many manufacturers offer excellent power-shovel equipment. Basically, the device consists of a large power-operated scraper blade

mounted on a cable. The scraper is moved toward the end of the car, and as soon as this motion stops, a power winch takes hold to drag the scraper toward the car door. Salt is pushed



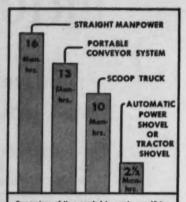
out through the door by the scraper. One man can unload a 40-ton car in 2 or 3 hours by this unique method. Both winch and motor for the power shovel must be permanently mounted on the dock or side of the building—but the installed cost of this equipment is moderate.

Small gasoline or electric tractor shovel, somewhat similar to a fork-lift truck, but with a scoop mounted in place of the forks. Many types are available, some having forks interchangeable with the scoop. One man on this type of truck can empty a 40-ton car in 2 to 3 hours—the equivalent of



power-shovel unloading. The higher cost of a tractor shovel, however, is often justified when it can be made available for other purposes.

Extra savings are possible with tractor shovels with scoop attachments. These



Comparison of time needed to empty one 40-ton boxcar of salt using different unloading methods.

trucks not only move salt out of the boxcar, but also transport it to any point of storage or use within the plant. This eliminates the need for various types of conveying equipment—either on the dock or in the plant. And manpower for handling salt in the plant is considerably reduced.

TECHNICAL SERVICE

Through skilled and experienced "Salt Specialists," International can help you get greater efficiency and economy from the salt you use. International produces both Sterling Evaporated and Sterling Rock Salt in all grades. And we also make automatic dissolvers in metal or plastic for both types of salt. So we have no reason to recommend one type of salt over another; we simply suggest the type and grade of salt most perfectly suited to your needs.

If you'd like help on any problem concerning salt or brine—or further information on salt unloading—contact your nearest International sales office.

International Salt Company, Scranton, Penna. Sales offices: Atlanta, Chicago, New Orleans, Baltimore, Boston, Detroit, St. Louis, Newark, Buffalo, New York, Cincinnati, Cleveland, Philadelphia, Pittsburgh, Richmond.

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Vol. I—Thermodynamic Properties

Contains 45 pages of introductory material and lists in English units, the function: enthalpy, entropy, mean molecular weight, density, sonic velocity (on both equilibrium and frozen composition bases), heat capacity and two non-ideality coefficients. The independent variable grid is: Temperature from 600° to 5000°R in 100°R increments; pressure, from 0.01 to 30 atm. in 22 increments on a quasi-logarithmic scale; equivalence ratio, from 0.25 to 4.0 in 15 increments approximately adjusted to the degree of non-ideality. The source data are taken from the National Bureau of Standards—American Petroleum Institute Publications.

Vol. II—Chemical Composition of Equilibrium Mixtures

Lists the equilibrium chemical composition of the mixtures in terms of the molfractions for temperatures above 2500°R on the same grid of independent variables which is used in Volume I. The following species are considered: A, C_a (graphite), CO, CO₂, H₂O, O₂, N₂, H, O, N, NO, OH, CH₄, and NH_a. All molfractions greater than 10°0 are listed. In addition, this volume contains tabulations of the enthalpy, Gibbs free energy, entorpy and heat capacity functions of the above pure species in 100°R increments in the range 600 to 5000°R.

This two-volume set of books will eliminate much of the laborious computation involved in considerations of the chemical compositions and thermodynamic properties of combustion gases. Comprised wholly of tables, with brief introductory text, the volumes provide an accurate knowledge of the thermodynamic properties and behavior of the working fluid of the air-breathing combustion engine under very wide ranges of operating conditions, and will contribute to a fuller realization of the performance levels

which are becoming practicable for air-breathing jet propulsion engines.

The tables are applicable to the combustion gases of any hydrocarbon fuel with a hydrogen to carbon ratio of two, independently of the fuel's chemical make-up or heating value. The books should be of value to those engaged in combustion research, development of gas turbines and turbojet engines, in aircraft and missile propulsion studies, and to chemical companies engaged in the high-temperature synthesis of materials from combustion-type reactors.

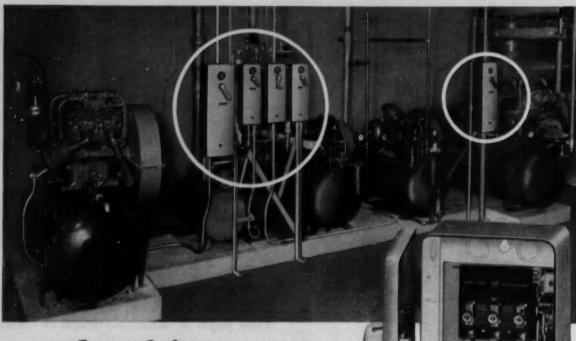
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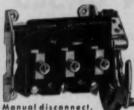
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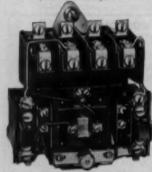
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Open contacts are visible in OFF position.





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Allen-Bradley combination starters...with manual disconnect, fuse clips, and automatic starter in ONE ENCLOSURE...are especially safe for maintenance and factory personnel.

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Two thermal relays protect the motor against any sustained overload. Their accuracy is not affected by long periods of relay inaction.

Send for the A-B Handy Catalog with full information about these "safety-first" combination starters.

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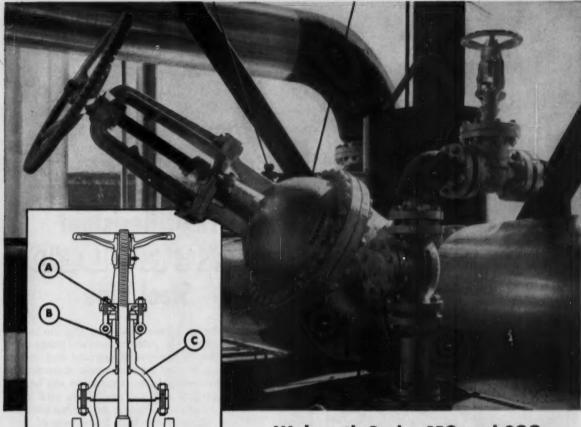
Allen-Bradley Canada Ltd., Galt, Ont.





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(B) DEEP STUFFING BOXES: More than adequate in all sizes (2" to 24") to assure tightness and maximum packing life.

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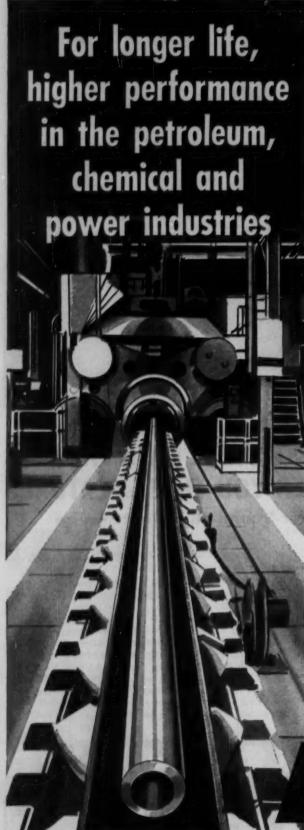
(F) STREAMLINED PORTS: Permit unobstructed flow which results in minimum pressure drop and reduces the possibility of erosion.

Walworth Cast Steel Gate Valves can be furnished with either flanged ends or butt welding ends. Roller bearing yokes are available on the larger sizes. On valves 4 inches and larger, by-passes can be furnished. Walworth Cast Steel Gate, Globe and Check Valves from Series 150 to 2500, are available. For Series 600 and higher, we recommend Walworth Pressure Seal Cast Steel Valves. See your Walworth Distributor or write to Walworth for complete information.

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Curtiss-Wright's Metals Processing Division now offers the petroleum, petrochemical and power industries a line of high-quality, extruded steel tubular products to meet the most severe demands of modern processing. Inherent corrosion and heatresistant properties of the steel alloys used are amplified by extrusion because the finished tube is produced with only one heat, in one pass of the giant 12,000 ton press . . . formed under compression in a matter of seconds without seams, in lengths up to 50 feet. Extra margins of resistance to corrosion and heat are built in easily by extruding heavier pipe wall thicknesses at no sacrifice in production speed. The most up-to-date quality control facilities, including ULTRASONIC TESTING. are employed in production.

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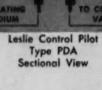
always in tune - - - each unit doing its part to create 24-hour-a-day harmony. They save time — no personal attention or manual assistance required after they're set. Pressures stay at set point for top efficiency of process equipment in the line. Positive response of pilot and valve assures smooth throttling action within closely held limits.

NEVER A DISCORDANT NOTE from this quartet - - - they're

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For more information on controllers that save maintenance dollars, consult the nearest Leslie Engineer listed in your classified telephone directory under "Valves" or "Regulators". Use this help for economy in temperature and pressure regulation.

Bulletin 5303 sings the whole song. Send for it today.



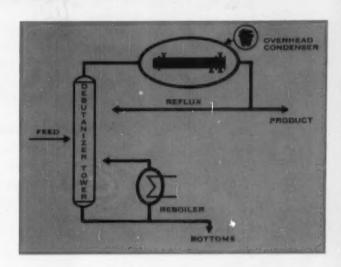


REGULATORS AND CONTROLLERS

LESLIE CO., 279 GRANT AVENUE, LYNDHURST, NEW JERSEY

Midwest Refinery Boosts Throughput 33%

- Integral finned condenser tube setting new heat transfer records
- Processing engineers take new look at extended surface condenser tube
- Roving reporter describes results of finned tube installations
- Manufacturer offers design information and operating data



by Ernest Dodd

During a recent swing through the major petro-refining areas of the Western States this writer was impressed by the amazing production records being established in plants using integral finned condenser tube. The tubing manufacturer is Wolverine Tube and the product is Wolverine Trufin* Type S/T.



It's pretty hard, for example, to ignore a 33% increase in throughput, particularly when it was obtained simply by retubing an existing overhead debutanizer condenser. In describing this increase to me, the Chief Processing Engineer of a large Midwest refinery, declared that his

plant's overall U had shot up from 140 to 210.

He also stated that in retubing, Wolverine Trufin was completely interchangeable with the formerly used prime surface tube. Exactly the same tools and standard tubing techniques were used. He was actually gleeful as he described how use of the integral finned tube increased the heat transfer surface area approximately 2½ times—without any increase in unit size or weight.

The principle of application of an extended surface tube to heat transfer problems has been well established for many years. However, its use in shell and tube condensers was not practical until Wolverine pioneered the use of integral finned tube. We predict that processing engineers in general are going to take a fresh look at this type of application as the good word spreads about the remarkable achievements of Wolverine Trufin Type S/T.

Design, Operating Information Obtainable From Manufacturer

Complete information on designing with extended surface tube, actual case histories and operating and fouling data are all described in a new Trufin Opportunity Book, according to an announcement by Wolverine Tube. The company maintains a Field Engineering Service for the assistance of any refinery or equipment fabricator considering the use of finned tube in heat transfer applications. Wolverine Tube's address is given below.



Wolverine Trufin is available in Canada through the Unifin Tube Co., London, Ontario

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riore's a tube designed to hands two types of corpolon simultane ously. It is composed of an oute tube of one metal and a liner a another. The combination can be the combination can be



DUPLEX TYPE B/T

This tube step is designed for specific sorrowive conditions. Like Trustin- It has integrat fine-will boost heat transfer efficiency.

If you're looking for the answer to increased heat transfer efficiency, chances are you'll find it among the Wolverine condenser tubes described on this page.

Supposing, for example, that you're faced with corrosive attack on both shell and tube side. The right tube for you is Wolverine Duplex because it gives you an outer tube of one metal mechanically bonded to an inner liner of an entirely different metal. The combinations can be of any two alloys you need to stop corrosion in its tracks.

On the other hand perhaps you're concerned with a lack of space—would like to reduce your replacement tube inventory. In this case just specify Wolverine U-Bend condenser tubes—you'll not only reduce inventory but you'll also slash retubing time.

One metal or two—finned or prime surface—you'll find that Wolverine has done its level best to help you come up with the right answer. It's the type of program that comes from years of metalworking experience plus a thorough knowledge of an industry's needs.

And if you're not quite sure where your trouble lies, Wolverine's Field Engineering Service can help you. FES is a staff of highly trained tubing technicians skilled in matters of corrosion, alloy selection, design, or fabrication. For complete information just write for Wolverine's Condenser Tube Catalog. It's your's without obligation.

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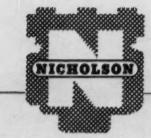


Model N-125 available through your local distributor, as well as your Nicholson representative.

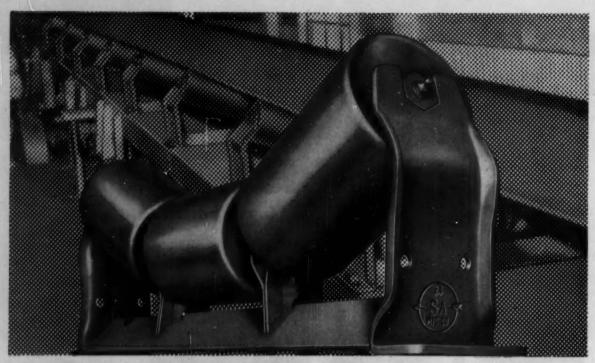
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CHEMICAL ENGINEER

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Desired qualifications will include substantial experience
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Duties are: Assistance in the preparation and analysis of basic information for design of operating units and cupporting facilities in order to obtain optimum performance with minimum investment and operating costs; preparation of flow sheets; evaluation of process afternatives; selection and approximate using of equipment; and establishment of heat and material balances. Position requires five or more years of experience in equipment selection, economic evaluation of processes, and development of information for design of industrial facilities.

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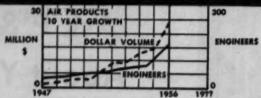
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CHEMICAL ENGINEERING

New York 36, N. Y.











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- 1-Devine 5'x10' Rotating Vacuum.
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- Hersey 3'x18', 11/2'x12' Rotary, 304

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- -2500 gal. 304 5.S. jacksted
- Reactor. 1—Pfaudier 5'x18" Horiz, glass lined 2500 gal. 1—7500 gal. 304 S.S. clad 12'x6'x
- 3-Link Belt 316 S.S. 18"x12", 18"x 10", 18"x7" Twin Conveyors. 200 ft. 18" Troughing Belt Conveyor with housing.

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- 2-Oliver Rotary, Monel 8'x10', 3'x2'.
- 1-Oliver 3'x4' 304 S.S. Rotary Vac.
- 1-Feinc 5'x7', 304 S.S. Rotary Vac.
- 1-Feinc 5'x3' Monel, Rotary Vac.
- Eimco 18"x24", 18"x12", 316 S.S. 2—5weetland #12, 72 anl 36 leaves.
- Sweetland #3, 75 sq. ft., 304 S.S. 2
- 1-Miagara 230-32 230 sq. ft. 304 S/S. 3-Shriver 30" P&F, 36 chambers, iron.
- 4-Shriver 24" P&F. 30 chambers, iron.

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- National 6"x12" Plastic two-rell
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- bowl Continuous. Bird 24"x38", 18"x28" 304 S.S. Solid Bowl, Continuou
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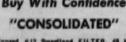
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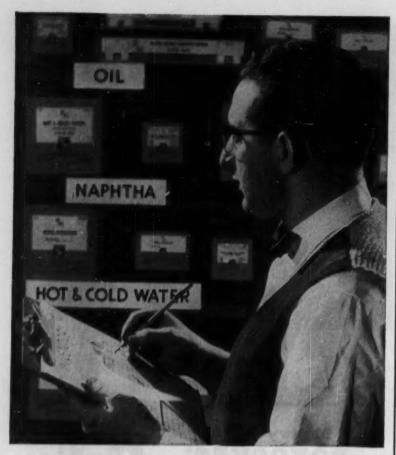
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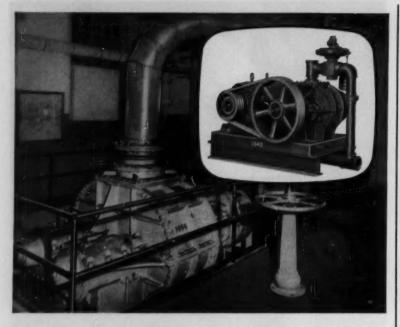
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- Acid Meriatic.....Features high purity muriatic acid-Hooker White. This special grade is entirely free of arsenic. Contains .003% or less suifates, & .0001% or less iron. Technical Data Sheet. *Hooker Electrochem. Co.
- Acid, Oleic.....Bulletin lists physical characteristics and constitutents of oleic acid, as well as some suggested applications. Request a sample of Double Pressed Red Oli (Oleic Acid) and Bulletin 05-54-0-5-56,
 464A Harwick Standard Chem. Co.
- Acids, Organic.....Intermediates for solventa, plasticisers, paint driers, synthetic flavors, pharmaceuticals. Physical properties, shipping data, specifications & test methods are discussed in Bulletin F-4768D.

 454B Carbide & Carbon Chem.
- Additives..... 8 p. bulletin explains how the lubricant additive Moly-Sulfide functions in chassis grease and details its properties and current technological status. Bulletin Lu-8a is available on request. 454C Climax Molybdenum Co.
- Aleohoi, Furfuryi.....Derived from agricultural residues & useful in manufacture of wide variety of products including resinous mortars, cements, binder resins, etc. Data on properties & uses in Builetin 305.

 491

 *Quaker Oats Co.
- Alumina, Activated.....Alcoa Activated Aluminas are among the most effective and efficient desicents available for the dehydration of liquids and gases. Furnishes complete information and product samples.

 239 *Aluminum Co. of America.
- Aluminum Chloride, Anhydrous.....Anhydrous aluminum chloride is of great
 importance in the manufacture of organic chemicals, synthetic rubber, gasoline and many other related chemicals. For details, see Bulletin AC-1.
 484D Bolvay Process Div.
- Anhydrides.....For acetate fibers, aspirin and other pharmaceuticals, photographic films, plastics and surface coatings, flavors and perfumes. Covers physical properties & shipping data, specifications, etc. Bul. F-3280B, 434E Carbide & Carbon Chem.

- Carriers, Catalyst.....Alundum carriers prove highly successful in reactions such as those involved in manufacture of phthalic anhydride, maleic anhydride and oxidation of ethylene. Full details in Bulletin No. 7. 454F Norton Co.
- Catalyst Supports.....Made of dense, rugged, chemically inert material have great resistance to breakdown no chemically reactive effect on processing. Used in suspending beds for active catalysts. Request data. 4546 Norton Co.
- Catalysts.....Plus values of Girdler Catalysts: application service; development service; analytical service; market service; advanced promotion. For complete details, see "Girdler Catalyst Facilities."

 *Girdler Co.
- Chemicals.....The purpose of the "Bakelite Review" is to inform industry of the latest developments and applications of plastics and synthetic resins. Issue covers detergents, polyethylene pipe, etc. Vol. 28, No. 2, 454H Bakelite Co.
- Chemicals..... Bulletin covers the Morningstar-Paisley family of related products—starches, dextrines, adhesives, chemical products. Gives good perspective of rapidly developing field of liquid adhesives.

 Paisley Products.
- Chemicals, Industrial.....20 p. booklet describes briefly complete line of Mathieson chemicals for industry. Covers organic, inorganic and specialty chemicals, linting characteristics, grades, containers, etc. 454U Olin Mathieson Chem. Corp.
- Chemicals, Organic, Synthetie.....Thirteenth edition of "Synthetic Organic Chemicals" presents properties, specifications, and uses of many products sold by Carbide. Handy manual on industrial organic chemistry. 454K Carbide & Carbon Chem.
- Chlorobeasenes.....Data sheets give complete lists of physical and chemical properties of monochlorobeasene, ortho- and para-dichlorobeasene, tri-chlorobeasene and 1, 2, 3, 4, 5-tetra-chlorobeasene.

 **Hooker Electrochem.
- Defeamers, Silicone.....Dow Corning
 "Antifoam B" disperses immediately
 in aqueous solutions. No stirring or
 agitation required. Ready to use &
 ideal for continuous processing. Request particulars and free sample.
 32 *Dow Corning Corp.

- Dilsocyanates.....Application data on principal urethane uses being developed for Nacconates users, including practical starting formulas, test data, & use results. For complete productdata, Bulletins I-17 to I-17E. 289 *National Ainline Div.
- Electrodes & Pewders, Spectroscopic....
 Catalog discusses initial purity obtained through intensive purification processes during manufacture, and maintenance of purity by special protective packaging, Cat. A-4004.

 National Carbon Co.
- Emulsions, Copolymer, Bookiet is a compilation of the work done with copolymer emulsions and their adaptation for paint use. Describes National's 12K series of Resyns. Available upon request.

 454M National Starch Products.
- Ethylene Amines.....Covers physical properties, specifications and applications of ethylene amines . . . ethylene diamine, diethylene triamine, triethylene tetramine, tetraethylene pentamine. Bulletin F-8163.

 454N Carbide & Carbon Chem.
- Finorecarbon Products...... 8 p. brochure describes forms, properties and uses of a wide range of fluorecarbon products—from plastic resins to acids and dielectric fluids. Booklet details types and grades available . 4540 M. W. Kellogg Co.
- Fermaldehyde.... Allied produces the basic raw material, methanol, at the same plant where the formaldehyde is made. Therefore, you can be sure of steady supply—and purity. Details on delivery, prices and services.

 185 *Nitrogen Div., AC&D
- Formaldehyde.....New technical bulletin, "Formaldehyde", summarizes, properties and uses of this important, versatile organic intermediate. Covers safe handling, materials of construction, storage and analysis. 149 "Heyden Chem. Corp.
- Glycols, Polyethylene Carbowax polyethylene glycols for water-soluble lubricants, cosmetics and ointments emulsifying agents, adhesives and paper coatings. For complete details, request Bulletin F-4772B.

 454P Carbide & Carbon Chem.

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[•] From advertisement, this issue

- Intermediates.....New HET Anhydride can be used to form salts with many metals, to form esters & amides, to cure & harden epoxy resins & to form condensation polymers. For complete information, request Bulletin 48. 224-5f *Hooker Electrochem. Co.
- Lauryl Chioride.....A complete breakdown on the physical and chemical properties of both the Technical and Refined Grades, which are both mixtures of n-alkyl chlorides ranging from Cis to Cis. 234-5d *Hooker Electrochem. Co.
- Lithlum Aluminum Hydride.....A specific agent for numerous organic reductions. Reference gives composition, properties, solubility, applications, typical reductions, handling, safety & storage data. Bul. 401-D. 455A Metal Hydrides.
- Lubricants, Mold.....Lubri-Flo is a powerful mold lubricant which can be used on white or light-colored stocks, as well as on brown or black stocks. Gives a smooth, dry surface that can be lacquered. Bul. 11-124-2-5-56, 455B Harwick Standard Chem. Co.
- Molybdeaum.....Series of bulletins present technical information and case histories on the use of molybdeaum as an alloying element in gray iron castings. Bulletin Nos. 1 & 2 in the series are now available. 455C Climax Molybdeaum Co.
- Molybdenum Boride Compounds.....

 "Refractory Molybdenum Borides" is
 a 6 p. bulletin describing applications; chemical, physical and mechanical properties; and preparation of
 molybdenum boride compounds.

 455D Climax Molybdenum Co.
- Molybdenum Silicides Companion publications on molybdenum silicides —Builetin Cdb-6, entitled "Refractory Molybdenum Silicides;" Builetin CH-23, entitled "Fabrication of Molybdenum Disilicide Parts."

 455E Climax Molybdenum Co.
- Menomers.....Folder gives important physical properties and suggested uses for the 36 monomers available from Carbide and Carbon Chem. Company makes copies of the monomers folder F-40033 available.

 455F Carbide & Carbon Chem.
- Pentaerythritol.....Perstorp Pentaerythritol is covered in bulletin giving general data, properties of 4 grades, applications, uses, and ways of computing the addition for the esterification. Bulletin Za 215 E. 455G Chas. A. Koons & Co.
- Plasticizers...... Bulletins deal with Witco #20 Softener, efficient and economical plasticizer. Bulletin R-11 lists properties and applications. Bulletin R-12 reports results of laboratory tests.

 455H Witco Chem. Co.
- Polyethylene Brochure introduces newest Grace chemical product. Grex high density polyethylene is a tough, versatile resin which remains stable over a wide range of temperatures. For details, see "Grex" Builetin. 4551 W. R. Grace & Co.
- Polyethylene.....Bulletin gives recent data available on processing and fabrication of Super Dylan polyethylene. Also gives typical physical properties and specifications. For complete details, see Bulletin C-6-216. 4554 Koppers Co.
- Polyphenyl, Chlorinated Aroclor 1248 is a highly stable chlorinated polyphenyl; does not support combustion up to its boiling range 652° to 725° F.; is non-corrosive. Request technical information. 277a *Monsanto Chem. Co.
- Polyvinyi Chloride Compounds New
 16 p. bulletin available on Vygen
 2201 Compound, a modified rigid
 PVC compound for calendering rigid
 thermoplastic post-formable sheets.
 For details, request Bulletin VC-2.
 455K General Tire & Rubber Co.



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"NATIONAL" Conveyor Dryers are built to specifications determined by experience gained through years of specialization in the Drying Machinery field. They incorporate many exclusive "NATIONAL" Developments which have established new standards for drying speed and efficiency. Like all "NATIONAL" Dryers, the Conveyor Types are engineered to assure unequalled uniformity and speed under critical drying conditions, and to provide the lowest possible cost per unit of product dried. They can readily be designed for uninterrupted, production-line connection with "NATIONAL" Extruders, Automatic Feeders or other special handling equipment, of either "NATIONAL" or other manufacture.

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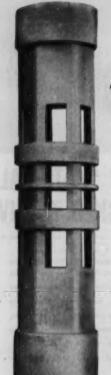
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LITERATURE . . .

Polyvinyl Chloride Compounds....Offers 8 p. bulletin on rigid unplasticized polyvinyl chloride compounds Geon 8700-A and 8750. Discusses the use of these compounds in manufacturing rigid vinyl pipe and fittings. 456A B. F. Goodrich Chem. Co.

Petassium Borohydride Detailed reference gives composition, properties, solubility, applications, typical reductions, handling, safety and storage information. Request copy of Technical Bulletin No. 301-B.

466B Metal Hydrides.

Resins, Plastisol.....Exon 654 is expressly created to impart excellent heat and light stability, physical toughness and chemical stability to your products. Request full information on entire product line.

163 *Firestone Plastics Co.

Sesquicarbonate of Seda..... Comprehensive booklet, "Snowflake Crystals and Snowfine," offers complete information on physical and chemical properties. Fully illustrated with photographs, tables and graphs.

152 *Solvay Process Div.

Silicones....."Silicones for Industry"
describes a new family of semi-organics with unusual properties...
rubber gums & compounds, resins,
fluids, emuisions, chemicals. Booklet
is available upon request.
456C General Elec. Co.

Silicenes....."Sliicones in Medicine and Pharmacy" shows how sliicones have proved capable of improving a variety of products and of facilitating many technical and clinical procedures. Available upon request. 4569 General Elec. Co.

Soda, Caustic....."Caustic Soda Buyer's Guide" contains helpful facts on economics of 50 % 473% solutions; other forms of caustic soda; capacities of tank cars & other containers; useful shipping data; etc.

224-5a *Hooker Electrochem. Co.

Sedium Borohydride.....MH sodium borohydride, MaBH, will reduce esters, acids, acid anhydrides, and acid halides. Announces the availability of detailed Bulletin 502-F and typical reduction procedure.

456E Metal Hydrides.

Sodium Hydride..... Makes available a detailed technical reference containing information on: composition; properties; solubility; applications; typical reductions; handling; safety; storage, Tech. Bulletin 507-C.

456F

Metal Hydrides.

Sedium m-Silicate......Valuable data on Drymet anhydrous—the most highly concentrated form of sedium m-silicate. Drymet File Folder contains complete technical information and suggested formulations.

B489 *Cowles Chem. Co.

Sodium Sulfide.....The clean, strong flakes dissolve right into process, even without stirring. No waiting-no decanting. For complete information on Hooker's sodium sulfide, request Technical Data Sheet. \$24-225e "Hooker Electrochem. Co.

Solvent Becevery.....General survey of solvent and air recovery by means of activated charcoal is now available. Details advantages and circumstances under which such systems may prove advisable. Bulletin W-356. 456H Barnebey-Cheney Co.

Solvents..... Describes Turco-Solv. a true detergent-action safety solvent. Compound is non-conductive, evaporates to complete dryness without leaving residue, requires no rinsing, is safe on all metals. Folder A-28.

4561

^{*} From advertisement, this issue

- Surface Active Agents.....Bulletin discusses "Tergitol" nonionic and anionic agenta, selection of surface active agents, properties, applications, performance data, shipping data and test methods. Bulletin F-5900D. 457A Carbide & Carbon Chem.
- Triacetate.....Ten new formulas for slashing Arnel triacetate, bringing the total available to 16, are contained in bulletin. Information on warping, weaving and quilling of Arnel. For details, see Bulletin TD-13A.

 457B Ceianese Corp. of America.

Construction Materials

- Alloys.....Hastelloy alloy D has excellent resistance to sulphuric acid in all concentrations and at temperatures up to the boiling point. Announces availability of a booklet which describes Hastelloy products.

 237
- Alumina.....Of many electrochemically refined materials produced by company, Alumdum fused alpha alumina is one of the most useful, Request "Norton Refractory Grain—Electrochemically Refined."

 *Norton Co.
- Aluminum.....Process Industry applications of aluminum for producing everything from beer to bomb shells are analyzed in illustrated, 80 p. book, "Process Industries Applications of Alcoa Aluminum" 293-300a *Aluminum Co. of America.
- Aluminum, Heat Exchanger Tubes....

 Alcoa Aluminum for heat exchanger tubes is low in cost, resists oxidation and other chemical attack, has excellent thermal conductivity, is easy to fabricate. Details in Hooklet AD186.

 293-300e *Aluminum Co. of America.
- Bearing Materials......Chart clearly shows complete chemical, mechanical, and work characteristics of a wide range of sintered bearing materials. Best material for most applications can be selected in minutes.

 4570 Bound Brook Oil-Less Bearing.
- Boron Carbide.....Data book, "Handbook on Boron Carbide & Elemental Boron" is a valuable reference containing both fundamental data & practical information. Useful to those interested in atomic energy etc. \$14
- Carbides, Cemented.....44 p. booklet provides mechanical information required by engineers who design parts that may call for the use of Kennametal or Kentanium. "Designing with Kennametal," Booklet B-222. 457D Kennametal Inc.
- Castings, Alloy.....Manual on heat and corrosion resisting castings contains information on principles of alloy composition, properties and limitations, stabilizing influences and heat treatment, etc. On request.

 457E Michigan-Standard Alloy.
- Castings, High Alloy.....Covers facilities for producing high alloy static & centrifugal castings & offers data on castings used for resisting high temperatures, corrosion & abrasion. See Bulletin No. 2254-G.

 *Duraloy Co.
- Coatings, Plastic..... Brochure on Ulti-Products covers specifications and uses of complete line of highly speclalized corrosion protective plastic coating products. Company makes brochure available on request. 457F Corrosion Protective Prods.
- Coatings, Protective.....Helps you figure cost per sq. ft. per year of service for any coating system. Gives complete details on Phenoline 305... system for longer protection against corrosion. Data Chart 1005. 369 *Carboline Co.

Hardinge 9' x 22' Pebble Tube Mill in an Ohio plant producing silica flour.

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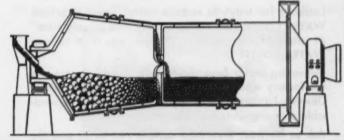
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Cement materials

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Looking for ways to reduce costs? Don't overlook WATER COSTS! Your company may own a "gold mine" of underground water. Why not use it to reduce WATER COSTS!

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LITERATURE . . .

- Centings, Protective....."Cold gal-vanise" existing steel structures with 100% inorganic zinc protective coat-ing. One spray coat protects against weathering exposures to sea air & sait water, Request Dimetcote Bul. 458A Americant Corp.
- Electric Furnace Shapes.....Literature covers electric furnace refractories—cores, tubes, muffles—of Alundum or Crystolon materials. Tells in detail how to construct electrical furnaces for laboratory. Bulletin 458, 488B Norton Co.
- Fabrication, Plate......Illustrated, 12 p. covers dozens of typical examples of plate fabrication work done by the company for chemical, refining, petrochemical, food and other process industries. Request Bulletin PF.

 14 *Downington Iron Wks.
- Flooring Materials.....Booklet covers: patching compounds vs. underlay-ments; principal subsurfaces; principal types of adhesives; painted floors; correction for damp concrete; product information. File No. 23Q. 4580 Allied Compositions Co.
- Grouting Materials..... Specifications for non-shrink grouting of heavy equipment, anchor boits, building columns, and bridge seats available in Spec. E-10. Functional Specification for non-shrink grout in Spec. E-9.

 4850 Master Builders Co.

 Insulations, Industrial.....No matter where your insulation job may be—Armstrong can give you efficient, well-integrated, on-the-job service from original specs to final installations. Booklets describe full line.

 79 Armstrong Cork Co.
- Linings, Corrosion-Resistant Com-pany offers complete design, instal-lation and maintenance or corrosion-resistant linings and tile tanks. Bulletin covers services and various construction materials. Bul. A-153. 458E Stebbins Engrg. & Mfg. Co.
- Linings & Tile Tanks..... Designed & in-stalled to meet the exact chemical & physical requirements of each instal-lation. Stebbins linings & tile tanks are famous for their efficiency & economy. Request Bulletin A-153. 392 "Stebbins Engrg. & Mfg. Co.
- Mortars, Chemical-Resisting.....Revised manual on corrosion proofing provides information on latest developments in this field. Includes descriptions of the application of Corloik, new type chemical-resisting mortar.

 458F Pennsalt Chemicals.
- Paints, Protective.....Tygorust & Tygon
 "ATD" are companion products to
 make your fight against corrosion less
 costly—more effective. You can get
 better protection. For the full story,
 request TYGON Manual.
 106 *U. S. Stoneware.
- Plastics..... "The ABC's of Modern Plastics" is an illustrated booklet containing basic facts on the sources and production of plastics & their growth and importance today. Copies are available on request. 4586 Bakelite Co.
- Polyvinyl Materials.....Products made from Geon rigid vinyl include corro-sion-proof pipe, fume ducts, tanks, trays, materials that can be machined, planed, sawed, drilled, and cemented. Booklet on Geon 8700A & 8750. 9 B. F. Goodrich Chem. Co.
- Refractories.....No other refractory is so chemically stable at such high temperatures under both oxidizing and reducing conditions. Includes fully detailed information on prop-erties in Bulletin No. 1741.
- Refractories, Castable & Plastic.....
 Harbison Walker complete range of castable and plastic refractories—balanced for the selection of the most serviceable product for each specific need. Request information.

 245 *Harbison-Walker Refractories.

^{*} From advertisement, this issue

- Refractory Grain.....24 p. reference,
 "Norton Refractory Grain," offers
 many charts, tables and photographs
 in color—a wealth of information on
 nature, performance, and application
 of refractory grains.

 4594
 Norton Co.
- Rings, Forged & Rolled, Seamless.....
 16 p. bulletin on production of seamless forged and rolled rings from ALCO-made steel. Chart showing weights for rings from one inch to 145 inches overall-diameter.
 459B Alco Products.
- Rubber & Plastic Materials..... Piping, pumps, valves and tanks have a wide range of temperatures, pressure, impact resistance. For details about Accrubber and plastic materials, request Technical Data CE-50.

 372a *American Hard Rubber Co.
- Bubber, Silicone....."Imagineering with Silicone Rubber" features properties and applications, available classes, designed specifications for silicone rubber parts compounded from General Electric silicone gums.

 4590 General Elec. Co.
- Steels, Rubber-Lined.....Ace rubber-lined steel... strength & pressures of steel plus chemical resistance of hard rubber. Excellent for alkalis, most inorganic acids, many organic acids, etc. Bulletin CE-52.

 378b *American Hard Rubber Co.
- Tantalum.....Tantalum is immune to hydrochloric acid, nitric acid, bromine, lodine, chlorine and many others. It is strong, immune to thermal shock, unequalled in heat transfer efficiency. See Tantalum Booklet.

 459 *Fansteel Metallurgical Corp.

Electrical & Mechanical

- Batteries, Stationary.....Catalog describes improvements in stationary batteries which are expected to extend service life up to ten per cent and reduce maintenance requirements. For details, see form 5907. 459D Elec. Storage Battery Co.
- Bearings, Rolling.....Data on SC and SCM Ball Bearings in Bulletin A63B. Details on Taper-Lock Steel Conveyor Pulleys in Bulletin D55. Dodge Take-Ups covered in Bulletin D56 also. Request your copies.

 **Podge Mfg. Co.
- Casters & Wheels.....Featuring Darnelloprene treads (a soft resilient Neoprene rubber compound) . . casters offer ease of movement, quietness, and protection for floors. See Manual for details. L473 *Darnell Corp.
- Clutches, Electric.....Electro Clutch, new element for the modern machine tool, is proven, simple, compact and economical. These features make it a valuable contribution to machine tool industry. Request Bulletin.

 459E 1-T-E Circuit Breaker Co.
- Drives.....U.S. Holloshaft, Type GPC, is a new right-angle combination drive developed for municipal water supply stations, sewage disposal plants, fire fighting stations, etc. See Bulletin 1775 and F-1912,

 459F U. S. Eleci. Motors.
- Drives, Belt.....No other belt drive can deliver as much power in the same space... delivers up to 50% more power than a conventional V-belt drive of equal width. Complete details in Poly-V Drive Bulletin 6628. 346b *Raybestos-Manhattan.
- Drives, Fiuld.....Bulletin discusses construction features and advantages of new Size 126 Type T Gyrol Fluid Drive for general industrial application. Request fully illustrated Bulletin No. 9715.
 4596 American Blower Corp.

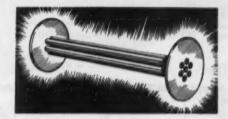
e make it a rule not to recommend tantalum unless it is the only right material for a particular process. And when we design tantalum equipment, we use it sparingly—an easy task in most instances because tantalum's strength and excellent heat transfer qualities make for minimum bulk. Where other materials of construction can be used in conjunction with tantalum, we specify them.

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Looking for ways to reduce costs? Don't overlook WATER COSTS! Your company may own a "gold mine" of underground water. Why not use it to reduce WATER COSTS!

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Ask us for free, illustrated Bulletin No. 6700 and the names of Deming Distributors in your area.

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LITERATURE . . .

- Centings, Protective....."Cold galvanize" existing steel structures with 100% inorganic zinc protective coating. One spray coat protects against weathering exposures to sea air & sait water, Request Dimetcote Bul. 458A
- Electric Furnace Shapes.....Literature covers electric furnace refractories—cores, tubes, muffles—of Alundum or Crystolon materials. Tells in detail how to construct electrical furnaces for laboratory. Bulletin 458.

 458B Norton Co.
- Fabrication, Plate......Illustrated, 12 p. covers dozens of typical examples of plate fabrication work done by the company for chemical, refining, petrochemical, food and other process industries. Request Bulletin PF.

 14 *Downington Iron Wks.
- Picoring Materials.....Booklet covers:
 patching compounds vs. underlayments; principal subsurfaces; principal types of adhesives; painted
 floors; correction for damp concrete;
 product information. File No. 23Q.
 458C Allied Compositions Co.
- Grouting Materials Specifications for non-shrink grouting of heavy equipment, anchor bolts, building columns, and bridge seats available in Spec. E-10. Functional Specification for non-shrink grout in Spec. E-9.

 456D Master Builders Co.
- Insulations, Industrial.....No matter where your insulation job may be—Armstrong can give you efficient, well-integrated, on-the-job service from original specs to final installations. Booklets describe full line.

 79

 *Armstrong Cork Co.
- Linings, Corrosion-Resistant Company offers complete design, installation and maintenance or corrosionresistant linings and tile tanks. Bulletin covers services and various construction materials. Bul. A-153. 458E Stebbins Engrg. & Mfg. Co.
- Linings & Tile Tanks..... Designed & installed to meet the exact chemical & physical requirements of each installation. Stebbins linings & tile tanks are famous for their efficiency & economy. Request Bulletin A-153, 393 *Stebbins Engrg. & Mfg. Co.
- Mortars, Chemical-Resisting.....Revised manual on corrosion proofing provides information on latest developments in this field. Includes descriptions of the application of Corlok, new type chemical-resisting mortar.

 458F

 Pennsalt Chemicals.
- Paints, Protective.....Tygorust & Tygon
 "ATD" are companion products to
 make your fight against corrosion less
 contly—more effective. You can get
 better protection. For the full story,
 request TYGON Manual.
 106 *U. S. Stoneware.
- Plastics......"The ABC's of Modern Plastics" is an illustrated booklet containing basic facts on the sources and production of plastics & their growth and importance today. Copies are available on request.

 458G Bakelite Co.
- Polyvinyl Materials.....Products made from Geon rigid vinyl include corrosion-proof pipe, fume ducts, tanks, trays, materials that can be machined, planed, sawed, drilled, and cemented. Booklet on Geom 8700A & 8750. 9 B. F. Goodrich Chem. Co.
- Refractories.....No other refractory is so chemically stable at such high temperatures under both oxidizing and reducing conditions. Includes fully detailed information on properties in Bulletin No. 1741.
- Refractories, Castable & Plastic.....
 Harbison Walker complete range of castable and plastic refractories—balanced for the selection of the most serviceable product for each specific need. Request information.

 245 *Harbison-Walker Refractories.

^{*} From advertisement, this issue

- Refractory Grain.....24 p. reference,
 "Norton Refractory Grain," offers
 many charts, tables and photographs
 in color—a wealth of information on
 nature, performance, and application
 of refractory grains.

 459 A Norton Co.
- Rings, Forged & Rolled, Scamless.....

 16 p. bulletin on production of seamless forged and rolled rings from ALCO-made steel. Chart showing weights for rings from one inch to 145 inches overall-diameter.

 469B Alco Products.
- Rubber & Plastic Materials.....Piping, pumps, valves and tanks have a wide range of temperatures, pressure, impact resistance. For details about Ace rubber and plastic materials, request Technical Data CE-50. 372a *American Hard Rubber Co.
- Rubber, Silicone "Imagineering with Silicone Rubber" features properties and applications, available classes, designed specifications for silicone rubber parts compounded from General Electric silicone gums. 4590 General Elec. Co.
- Steels, Rubber-Lined.....Ace rubberlined steel...strength & pressures of steel plus chemical resistance of hard rubber. Excellent for alkalis, most inorganic acids, many organic acids, etc. Bulletin CE-52, 373b *American Hard Rubber Co.
- Tantalum.....Tantalum is immune to hydrochloric acid, nitric acid, bromine, iodine, chlorine and many others. It is strong, immune to thermal shock, unequalied in heat transfer efficiency. See Tantalum Booklet.

 459 *Fansteel Metallurgical Corp.

Electrical & Mechanical

- Batteries, Stationary.....Catalog describes improvements in stationary batteries which are expected to extend service life up to ten per cent and reduce maintenance requirements. For details, see form 590?. 459D Elec. Storage Battery Co.
- Bearings, Rolling......Data on SC and SCM Ball Bearings in Bulletin A63B. Details on Taper-Lock Steel Conveyor Pulleys in Bulletin D56. Dodge Take-Ups covered in Bulletin D56 also. Request your copies.

 375a

 Dodge Mfg. Co.
- Casters & Wheels.....Featuring Darnelloprene treads (a soft resilient Neoprene rubber compound) . . . casters offer ease of movement, quietness, and protection for floors. See Manual for details.

 *Darnell Corp.
- Ciutches, Electric.....Electro Clutch, new element for the modern machine tool, is proven, simple, compact and economical. These features make it a valuable contribution to machine tool industry. Request Bulletin.

 459E I-T-E Circuit Breaker Co.
- Drives....U.S. Holloshaft, Type GPC, is a new right-angle combination drive developed for municipal water supply stations, sewage disposal plants, fire fighting stations, etc. See Builetin 1775 and F-1912.

 459F
 U. S. Eleci. Motors.
- Drives, Belt.....No other belt drive can deliver as much power in the same space...delivers up to 50% more power than a conventional V-belt drive of equal width. Complete details in Poly-V Drive Bulletin 6628. 346b *Raybestos-Manhattan.
- Brives, Fluid..... Bulletin discusses construction features and advantages of new Size 126 Type T Gyrol Fluid Drive for general industrial application. Request fully illustrated Bulletin No. 9719.

 American Blower Corp.

e make it a rule not to recommend tantalum unless it is the only right material for a particular process. And when we design tantalum equipment, we use it sparingly—an easy task in most instances because tantalum's strength and excellent heat transfer qualities make for minimum bulk. Where other materials of construction can be used in conjunction with tantalum, we specify them.

All this is an effort—and so far, it has been a successful effort—to lower processing costs. The benefits of tantalum's complete immunity (not mere resistance) to most corrosive reagents are now obtainable at final operating costs far less than the costs of processing without tantalum.

Why not discuss your corrosion problem with Fansteel engineers for a practical, unbiased recommendation? There is no obligation, and consultations are kept in strictest confidence.

USE TANTALUM WITH ECONOMY for most acid solutions and corrosive gases or vapors.

Not recommended for HF, strong alkalis or substances containing free SO3.



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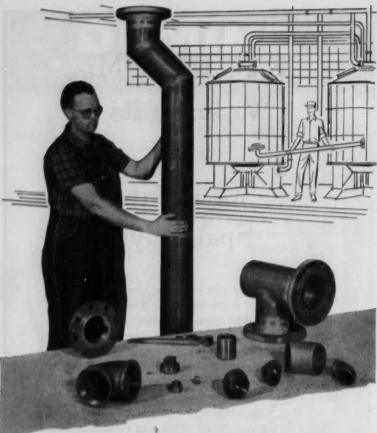
FANSTEEL METALLURGICAL CORPORATION
Chemical Equipment Division

NORTH CHICAGO, ILLINOIS, U.S.A.

G561A

TANTALUM...
We know its
value
We use it
Sparingly

[•] From advertisement, this issue



AMPCO PIPE and FITTINGS

resist corrosive action of fatty acid hydrolysis

Ampco Pipe and Fittings resist corrosion, erosion, and cavitation-pitting of a wide range of alkalies and acids

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High velocity tolerance flow rates of 18-20 fps

Thread not distorted by wrenches or hammers no leakage

Ampco Pipe and Fittings are made from a unique aluminum-bronze alloy that takes the trouble out of handling troublesome, corrosive media.

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You can get Ampco Pipe in all standard sizes. many from stock. Fittings are available to 3000 pounds; flanges, to 5000 pounds.

Write us concerning your problem.

AMPCO METAL, INC.

Dopt. CE-9, Milwaukee 46, Wis. . West Coast Plant: Burbank, Calif.







LITERATURE . . .

Drives, Fluid.....Publication covers friction and fluid drives for industrial applications and includes articles and timely tips on the efficient use of these drives. Request "Production Road," Vol. 18, No. 2.

460A Twin Disc. Clutch Co.

Drives, Hydraulie....."Industrial Rotat-ing Hydraulic Drives" is a reprint of Mr. Milton G. Malmquist's talk on "Automation" and its application in performing operations on continuous webs. Request Bulletin 15011. 460B Oilgear Co.

Drives, V-Belt.....Easy to read self-mailers are intended to help users of V-Belt Drives diagnose many of the common causes of trouble in their drives. Mailers #1, #2 and #3 are available upon request. 460C Worthington Corp.

Gaskeis.....Do not show any signs of creeping or distress at 1650 psi steam pressure—850°F. Gaskets come in all sizes and shapes. Detail on asbestos sheet packing and gaskets are made available in Bulletin CE96. 395

*Durable Mfg. Co.

Gaskets & Adaptors.....Company offers literature on Jacketed Gasket, Type 1-328 WA, Chemiseal Snap-on Type \$20 Gaskets and Chemiseal Adaptors No. 2-CRS. For full information, re-quest Bulletin No. TG-953. \$78a *U. S. Gasket Co.

Gears.....Duti-Rated Gears are spe-cially heat-treated for increased tooth surface hardness & produced to high precision tolerances. Offers informa-tion & technical data on styles & sizes available. Manual DR-2. 320b *Foote Bros. Gear & Mach.

Gears, Worm.....Makes possible a line of quality standard & special worm gear sets. Available for special operating & service conditions. Request complete catalog of ratings & dimensional data, Manual SW-1.

339a *Foote Bros. Gear & Mach.

Lighting Units...... Holophane fluorescent unit for general indoor lighting ... light weight Luminaire gives full prismatic control; offers major advantages in installation and maintenance. See Bulletin 1-50M.

460D Holophane Co.

Motor Units.....Rugged in construction and simple in design, Chapman Motor Units insure longer life with fewer repairs. Smooth, accurate and trouble free operation. For details, request Catalog 51. Chapman Valve Mfg. Co.

Motors.....Complete condensed motor catalog covers: cross reference between old and new NEMA ratings both hp and dimensions; current pricing for 1/20 through 1000 hp motor sizes; standard motor modifications.

460E Marathon Elec. Mfg. Corp.

Motors.....Descriptions and illustrations are included of open-type Uniclosed designs, totally-enclosed and explosion-proof types, Varidrives, Syncrogears, and right-angle worm gear models. See Bulletin 1878.

160F

U. S. Elecl. Motors.

Motors, Flat-Type..... New flat-type mo-tor, in totally-enclosed fan cooled or totally-enclosed non-ventilated de-signs, provides maximum horsepower with minimum size. Company makes details available on request. 4006 Diehl Mfg. Co.

Motors, Synchronous..... Describes con-struction features of Allis-Chalmers large end-shield bearing synchronous motors. Meet demand for high degree of protection with maximum accessi-bility. Bulletin 65B395. 460H Allis-Chalmers Mfg. Co.

Meters, Traction.....Traction motor for low-voltage electric vehicles improves operation 5 ways: more efficient uphill climb; easy installation; maximum loads; lower battery drain; minum maintenance. Bul. GEA-652.

4601 General Elec. Co.

^{*} From advertisement, this issue

- Packings.....Definite savings in maintenance costs....when you use spiral or die-moided ring packings. Means long uninterrupted sealing service with less wear on rods, shafts, sleeves or stems. File No. DMCE.

 B387 **Durametallic Corp.
- Packings, Plastie..... "Versi-Pak" is primarily designed for solvent and oil service up to 350°F. and 600 psi. Also does a superior job on water solutions, weak acids and caustics. For details, see booklet.

 448

 *Raybestos-Manhattan.
- Packings, Saddie.....Packs without "nesting," surface area is exposed area, more uniform free space, better liquid distribution, better drainage, less weight. Full technical data in Bulletin No. S-29.

 141 °U. S. Stoneware.
- Reducers Chemiseal Reducers No. 3-CRS are one piece assemblies, designed to connect unlike pipe sizes with minimum length requirements. Standard sizes from 1" to 6". For details, see Bulletin No. 3-CRS. 378e "U. S. Gasket Co.
- Reducers, Motor..... Motors can be interchanged or replaced in minutes with the all-steel Falk motoreducer. Replacement is not limited to original make of motor. For more information request Bulletin No. 3100. 286
- Reducers, Speed.....Feature all advantages of shaft-mounting...all proven performance & economy features of Dodge Torque-Arm speed reducers—available for your big jobs. Bulletin offers complete details.

 374

 *Dodge Mfg. Co.
- Reducers, Vertical Speed.....The unique single casing and bolted-on motor construction makes mounting and installation simple and it eliminates base plates and couplings. For details on MotoReducer, Cat. MR-54. L467 Philadelphia Gear Wks.
- Relays, Electronic Data Sheet describes new electronic relay designed to be safe for water-bath operation. Four-way panel switching, "fail-safe" operation, and DC circuit are discussed. Request your copy, 461A Arthur S. LaPine & Co.
- Relays, Ratio.....Unique Hagan device fills need in pneumatic process control systems for a relay which will permit the operator to adjust the ratio between input and output signals. Specification Sheet SP4315. 94 *Hagan Corp.
- Saddles, Rings & Fittings.....Complete
 line of Lenape elliptical manhole saddles, rings and fittings for pressure
 vessels described in bulletin. Includes
 specifications, finish and application
 data. Bulletin 565.
 461B Lenape Hydraulic Pressing.
- Seals, Mechanical.....For pumps, agitators, autoclaves and similar processing equipment. Furnishes the complete story of new line of Chempro "wedge-lock" mechanical seals in illustrated Bulletin No. CP551.

 389 **Chemical & Power Products.
- Seals, Mechanical, Rotary.....Company announces the availability of an 8 p. reference which shows how you get maintenance-free sealing that slashes fluid mixing cost to a new low. See illustrated Bulletin B-111. 127g *Mixing Equipment Co.
- Seals, Shaft.....Tefion wedge shaped sealing member is impervious to chemicals and solvents—permits high temperature service to 500°F. For complete details on the Type 9 Shaft Seal, request Bulletin 8-205-2.

 362 *Crane Packing Co.
- Switches, Automatic Transfer.....When normal power falls this switch transfers the load & retransfers. Delayed transmission permits system stabilization to be attained. For complete information, see Builetin 905. 343 *Automatic Switch Co.

THE Petch IS IMPORTANT IN A

WARREN-QUIMBY

SCREW PUMP



The capacity of this pump is determined by the "pitch" of the screws and the full load speed of the motor. Expert engineering knowledge of just the right pitch, number of threads, experience data, and precision workmanship are all mighty important in this highly specialized type of pump. It is available in two general types:/

Gear-in-head, with internal gears and bearings, for handling lubricating liquids free of corresive elements and solids.

Double External Bearing and Gear, with separately lubilcated gears and bearings, for handling all other liquids.

Standard pumps include jacketed, unjacketed, horizontal, vertical pedestal, vertical bulkhead, long body and hopper types in all machinable metals. Capacities, up to 3000 g.p.m. and pressures up to 700 p.s.i. on low viscosity liquids, and practically unlimited for high viscosity liquids which will flow into the pump inlet.

For specialized services involving hard-to-handle materials, insist upon Warren-Quimby, the original Screw Pump... now owned, greatly improved, manufactured, serviced and guaranteed by Warren... one of the pioneers of the Pump Industry.



Centrifugal * Reciprocating * Rotary
Write for Bulletin WQ-8208



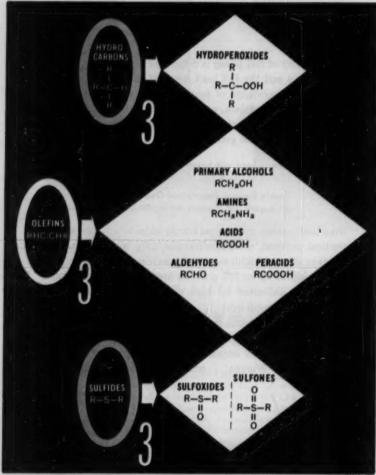
WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

Warren, Massachusetts

[•] From advertisement, this issue

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OZONE is the versatile new tool for low cost organic synthesis which features specific, high yield reactions with proven dependability and the utmost in convenience. Information and equipment from laboratory size to tonnage plants are available from

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LITERATURE . .

Transformers, Variable.....The Powerstat line offers new standard aircooled type transformers for manually-operated or motor-driven duty; the oil-cooled models; the explosionproof units. Request literature. 31 *Superior Electric Co.

Transmissions, Variable Speed.....New line of "Maureymatic" variable speed transmission provides simple, low cost speed adjustment for machines using up to 10 hp V-beit Drives. Catalog is available on request.

462A Maurey Mfg. Corp.

Transmitters, Pressure.....Model "P"
pressure transmitter, a lightweight,
rugged, yet highly sensitive unit, operates on force-balance principle and
is ideal for services involving viscous
substances. Bul. P-2520-2.
462B Conoflow Corp.

Turbines, Mechanical Drive.....From smallest type JR up to the largest multistage, Elliott turbines have the design, construction and flexibility to do the job well. Request information and descriptive bulletins.

60-1 • Elliott Co.

Turbines, Solid-Wheel.....Feature reliable, trouble-free operation. Rugged construction and superior design result in savings by keeping maintenance costs down to a minimum. Full details in Bulletin No. 8-116. 92 *Terry Steam Turbine Co.

Handling & Packaging

Belts, V-.... Product Bulletin furnishes comprehensive information on company's line of R/M Super-Power V-Belts ... with 46% more horsepower capacity where needed. Request your copy of illustrated Bulletin No. 628. 346e *Raybestos Manhattan.

Belts, V..... Veelos adjustable v-belts assures faster, cleaner work, less vibration, cooler running, greater fiexibility & simple installation. Veelos Data Book contains valuable engineering data. 384 Manheim Mfg. & Belting Co.

Bins, Bulk Storage.....Patented cable suspension anti-bridging discs keep products free flowing in Day bulk storage bins. These bins are available in black iron, galvanized or stainless steel. Request details.

462C Day Co.

Conveyers, Belt.....Bulletin features operational features, advantages and new ease of adjustment given newly designed Speedlift by its newest exclusive feature: hydraulic adjusting control unit. Bulletin SL 556. 462D Speedways Conveyors.

Conveyors, Dragline.....24 p. book covers design, application and installation of overhead and in-the-floor types of dragline conveyors, known as Trukveyors. Company makes Book 2497 available upon request. 462E Link-Belt Co.

Feeders, Liquid.....Continuous loss-inweight feeder for liquids excels in accuracy, capacity, memory, fiexibility and feed range. Application versatility & feeding mechanisms available covered in Bul. 31-M3. 462F Omega Machine Co.

Feeders, Solid.....Omega continuous lossin-weight feeder for solids causes a decrease in processing cost, manpower, and plant space with an increase in throughput, quality and efficiency. See Bulletin 30A-MS. 462G Omega Machine Co.

^{*} From advertisement, this issue



LITERATURE . . .

Feeders, Wet Reagent.....Accurately meter minute quantities of liquid from 0 cc to 2000 cc per minuts. Float valve in tank permits connection of feeder to bulk storage device. Data in Bulletin F6-B9.

391e *Denver Equipment Co.

Feeders.....Describes and illustrates Fuller's line of roll and vane-type feeders and rotary valves. Feeders are designed to handle a large variety of dry pulverized and granular materials. Bulletin No. F-5.

Feeders.....Prater offers Blow-Thru
Feeder for pneumatic systems. Available in cast iron and bronze. Power
requirements vary according to the
fineness and abrasiveness of the product. New Airlock Catalog.
412 *Prater Pulverizer Co.

Fillers & Packagers.....Automatically control delivery and packaging of plant, process or end-product liquids faster at lowest cost with Bowser systems. For full information, request product catalog.

B463e *Bowser, Inc.

Fillers, Vacuum.....Complete bottling machinery—air cleaning, gravity and vacuum filling, capping and labeling. Bulietin gives design and performance specifications for Rotavac filler. See Bulletin 120. 1465 *Pneumatic Scale Corp.

Float Boxes, Packless.....For handling volatile or flammable fluids. Sealed. flexible joint, minimum maintenance, higher sensitivity, less friction. Operates control valves from 4" to 8". See product bulletin. L475e *Davis Regulator Co.

Lifts.....New mobile access lifts assure safe working conditions up to 40 feet above floor level. Designed for countless operations in production, installation and maintenance. Request complete information.

483A Ballymore Co.

Magnets......"Magnetic Ideas From Erles" contains case histories explaining how various firms use permanent, non-electric magnets to prevent iron contamination in their products. Illustrated, 24 p. Brochure B-213. 463B *Erlez Mfg. Co.

Material Handling Equipment.....52 p. book includes specifications and illustrations of entire line of current model fork lift trucks, platform lift trucks, load carrying trucks, tractors and trailers. Catalog 400,

4630 Mercury Mfg. Co.

Materials Handling, Bulk-Flo..... Equipment designed to reduce handling costs on wide range of materials. Features ability to feed, convey, elevate in one compact, fully enclosed assembly, 28 p. Book 2475.

Tink Belt Co.

tell Handling.....Roll handling methods and equipment—ranging from heavy duty electric fork trucks equipped with clamps and attachments to 2wheel hand trucks—are described in detail. See Application Analysis 151. 463D Lewis-Shepard Products.

Scales.....Toledo's new Scale Check Chart will show you quickly and accurately how well your scales are serving you, and provide the information you need for effective cost control. Chart is available on request. 452 *Toledo Scale Co.

Scales, Bagging High-speed automatic bagging scale accurately proportions and bags 10 or more sacks of dry aggregate ingredients per minute. Fspecially useful in "do it yourself" dry-mix concrete market. Details.

463E Richardson Scale Co.

Scales, Shipping, Grain.....Large volumes of free-flowing grain can be rapidly and accurately weighed by automatic bulk grain shipping scales ... Class MM and Class MMM scales are covered in Bulletin No. 1148A. 463F Richardson Scale Co.

• From advertisement, this issue

FLEXIBLE TUBING Made from TEFLON*

For

Chemical Feed Lines (laboratory, catalyst, pilot plant reusable), Hot Corrosive Liquids or Steam Lines, Hydraulic Hose, Braiding and Fittings for Pressure Use

And Similar Applications Where Only PF TEFLON* Can Do The Job

PROPERTIES

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Pa. F. flexible tubing is available in a full range of colors and sizes. Our extrusion techniques yield maximum service flexibility and all sizes are carefully inspected and controlled dimensionally.

Write, wire or 'phone for additional details, competent engineering assistance and prompt attention to special sizes and walls. Pressure testing and certification upon request.

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for Tetraffueroethylene resin



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No Matter What Your Present or Future Heavy Pumping Problems Are . . . Morris Can Satisfy You NOW!

The new Morris Type RX Slurry Pump is specifically engineered to handle the viscosities, densities and special characteristics of the slurries and sludges developing from industry's everadvancing products. It is engineering attuned to the future . . . designed to meet the demands of a towering tomorrow.

Rugged, Dependable, Trouble-Free; Operates With Minimum Attention . . . Cuts Maintenance Costs!

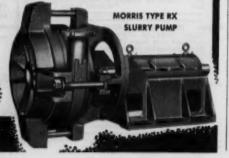
The new Morris RX is designed for performance perfection under all conditions, including heavy, coarse, fine slurries, dispersions and sludges. Operates at low speeds; quickly dismantled for inspection, avoiding lengthy lay-up time.

MORRIS MACHINE WORKS

Baldwinsville, N. Y. Sales Offices in Principal Cities

FREE SERVICE: Morris engineers will gladly recommend the custom-made pump best suited to your needs. Send necessary data taday.





LITERATURE . . .

Separators, Magnetie.....Type K magnetic separator provides a powerful magnetic field which attracts feebly magnetic particles. Purifies & concentrated bulk chemicals where other methods fail. Bulletin No. 701B.

*Stearns Magnetic.

Tanks, Tile.....Bulletin covers: tile shapes; standard reinforcing bars; wood pulp fibre in solution; capacities of tanks; table of circles; table of spheres; conversion factors; etc. Request Bulletin TC-155.

464A Stebbins Engrg. & Mfg. Co.

Tractor-Loaders TL-6 Tracto-Loader features a short turning radius & combines a tip-back bucket with hydraulic torque converter drive & clutch-type transmission. Illustrated features & specifications.

171

Tractomotive Corp.

Tractors, Gas......4 bulletins describe
Mercury gasoline tractors: Bulletin
T-103 covers model 930 Huskle; Bulletin T-104 covers model 940 Huskle;
Builetins 'T-105 and T-106 cover models 950-S and 950-H Super Huskle.
464B Mercury Mfg. Co.

Traps, Pipeline.....Illustrated brochure on new liquid-handling magnetic pipeline traps. Gives construction information, dimensions and installation instructions for both models. Request Bulletin No. B-605. *Eries Mfg. Co.

Trucks, Electric Fork....New "E" model electric fork truck—electric power gives 3 times longer life than other type trucks... lubricated-for-life...only 50¢ a day for battery charging...magnetic controls. Cat. 32-1.

464D Lewis-Shepard Products.

Trucks, Fork Lift...Allis-Chalmers FT series fork lift truck starts, steers, drives and shifts like an automobile. Safest in the field ... most advanced design ... most maneuverable ... most serviceable Catalog BU-300-554, 464E Allis-Chalmers Mfg Co.

Trucks, Hand Lift......Catalog discusses hydraulic and mechanical hand lift trucks and skid platforms. Covers construction features, specifications, advantages, etc. Company makes details available in Catalog 26.

464F Lewis-Shepard Products.

Vessels, High Pressure.....Cole can build you the kind of high-pressure tanks or vessels you require... any size, any shape, any metal. For complete product information, request copy of catalog, "Tank Talks."

T482 "R. D. Cole Mfg. Co.

Vibrating Equipment.....Present a 232
p. fully illustrated catalog—a complete and concles reference book covering electric and mechanical vibrating equipment and magnetic separators. Request Catalog No. 870, 267
*Jeffrey Mfg. Co.

Vibratory Equipment.....Ellsetro-permanent magnetic Hf-Vi vibratory equipment needs no rectifier. Operates at 3500 CPM directly off an AC line. Units are automatically self-adjusted. Request data.

*Eries Mfg. Co.

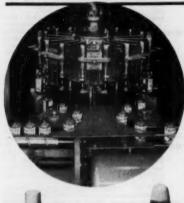
Heating & Cooling

Boilers......"Meet the Titusville Boiler Family" includes a wide range of Titusville power and heating boilers, providing from \$7 to more than \$.000 square feet of heating surface. Request Bulletin B-2300-A. Struthers Wolls Corp.

• From advertisement, this issue

PNEUMATIC

Rotavac





ROUND THEY GO

for fast no-drip filling!

Speeds of up to 250 per minute are quite practical on Pneumatic's smooth running, space saving ROTAVAC vacuum type filler. It handles light and heavy liquids equally well—alcoholic or oil base. Containers may range in size from one ounce to the standard one gallon jug.

Made in 18 and 30 head models, employing an exclusive fill principle which permits accurate control of filling heights with absolutely no drip or spatter!

Many of the country's most famous pharmaceuticals, soaps, chemicals, liquors, cosmetics and condiments are filled on this compact, stream lined unit. Send for Bulletin No. 130, giving complete design and performance specifications. Complete bottling machinery—air cleaning, gravity and vacuum filling, capping and labeling.

PNEUMATIC SCALE CORP., LTD., 85 Newport Ave., Quincy 71, Mass. Also: New York; Chicago; Dallas; San Francisco; Los Angeles; Seattle; Leeds, England. Canadian Division: Delamere & Williams Company, Ltd., Torento.



Packaging and Bottling Equipment

LITERATURE . . .

Condensers, Evaporative.....Stainless— 2—150 tons. Suitable for indoor or outdoor location. Quiet operating. All prime surface condensing coil. Available to your specifications. Request further information.

*Marlo Coil Co.

Condensers, Steam.....Conseco condensers have: deep water boxes; wide tube spacing; outside steam belt; quick opening doors on water boxes; full deaerating hotwell. Catalog presents complete information.

465A Condenser Service & Engrg.

Coolers. Cascade.....Designed for cooling corrosive liquids and gases. Low initial cost and maintenance, radiused returns for low pressure drop as well as redwood waterguide strips. Catalog Section No. S-6820.

2336 *National Carbon Co.

Deaerators.....Tells why this type of deaerator economically provides supply of hot water free from objectionable odor or taste that might be due to steam and fully deaerated to prevent corrosion. Publication 4654. 465B

Evaporators..... Swenson high-velocity LTV pressure evaporators generate essentially all of the process vapors used in modern beet sugar factories. Give heat economies of approx. 500,000 BTU per bag of sugar. Request literature. Swenson Evaporator Co.

Evaporators.....Quality products now being produced at low cost are: biochemicals; innulin—higher quality, potency yield; vanilla extract—high total solids with only small alcohol loss. See Bulletin 300. B485

Exchangers, Scraped Surface.....Vogt scraped surface exchangers offer these advantages: positive flow-thru; uniform heat transfer rates; rotating scraper blades; closed pressure-type systems. Bul. PE-1. 174 "Henry Vogt Mach. Co.

Furnaces..... Pulletin describes 3 models of Surface Allcase furnaces. Can be used equally well for gas carburising, clean hardening, dry cyaniding, carbon restoration. clean annealing, oll quenching. Bulletin SC-174.

4650 Surface Combustion Corp.

Furnaces, Melting......3 p. catalog describes complete line of auxiliary items commonly used in conjunction with melting furnaces in the foundry. Company makes complete details available in Catalog No. 661. 465D Lindberg Engrg. Co.

Generators, Steam.....16 p. book gives capacities. dimensions, construction features, instrumentation, accessories, sectional drawings & installation photos on new series of steam generators. Bulletin PG-55-3,

*Foster Wheeler Corp.

Heat Exchangers.....Full description of Chromalox electric circulation heaters and methods of applying for controlled heating of water, oils, heat transfer media, steam and air and other gases. Product Bulletin No. 701.

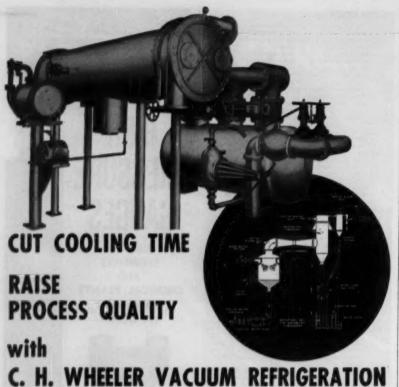
Heat Exchangers...... Describes how equipment offers: chemical resistance to practically all corrosive fluids; resistance to severe thermal shock; high heat-transfer rates; low maintenance; etc. Catalog S-6746, 233d *National Carbon Co.

• From advertisement, this issue

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the product.





Employing the principle of flash evaporation, here's what C. H. Wheeler Steam Jet Vacuum Refrigeration will give you in food processing:

Low initial cost of equipment in standard assemblies consisting of steam jet ejectors, boosters, barometric or surface condensers and water pumps • Low installation cost • Low cost operation using plant steam at pressures down to 2 psi • Savings in space in plant, on roof or outdoors • Savings on maintenance, because there are no moving parts in a steam jet vacuum system except the chilled water pump • Uniform production capacity, because there is no wear or scale formation • Easy operation with either manual or automatic instrument control • Overload capacity without damage • Economical operation at part load • Maximum safety, no noxious gases, no pressure or explosion hazard • No noise or vibration • Cooling to any temperature above 35° F.

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Investigate the possibilities in your plant for C. H. Wheeler Steam Jet Equipment. Write for Bulletin 1462 and name of nearest representative.

C.H. Wheeler

LITERATURE . . .

- Heat Exchangers.....Iliustrates and explains the functions of new equipment to provide cooling of liquids in industrial plants independent of a large supply of cooling water and with additional savings. Bulletin 132.

 466A Niagara Blower Co.
- Heat Exchangers......Aero heat exchanger cools liquids & gases by evaporative cooling with atmospheric air, removing the heat at the rate of input, controlling temperature precisely. Data in Bulletin No. 120.
- Heat Exchangers.....For corrosive or non-corrosive liquids and gases. Industrial builds these to suit the job and can furnish all auxiliary pumps, piping and fittings. Request Bulletin No. 600-2. 407 *Industrial Filter & Pump.
- Heat Exchangers, Shell & Tube.....Type
 "SSF" stainless steel heat exchangers
 ...specially designed for heating
 liquids and gases in industries where
 elements of corrosion to alloys are
 encountered. Catalog 1155.
 466B Young Radiator Co.
- Heat Exchangers, Shell & Tube.....Type
 "F" fixed tube bundle heat exchangers—over 180 standard models. Offer
 greater initial and operating economies... more cooling surface per unit
 volume of space. Catalog 1254.
 466C Young Radiator Co.
- Heat Transfer Systems......Capacities can range from small portable units to large gas—or oil-fired units generating from 250,000 to over 10,000.000 B.T.U.'s per hour. Request names of designers & manufacturers.

 **Monsanto Chem. Co.
- Heaters, Electric....Information and design selection charts on strip heaters, natural and forced convection air heaters, oven heaters, immersion heaters, cartridge heaters, melting pots, etc. included in Bulletin 27-620.

 466D Westinghouse Elec. Corp.
- Heaters, Gradiation.....Makes available detailed literature—"Try the Gradiation Heater for Economical Ethylene Production" and bulletin. "Gradiation Heating for Petroleum and Chemical Processing."

 382 "Selas Corp. of America.
- Heaters, Process.....Speedytherm process heater may be used either for liquid or vapor phase heating. Dimenisons, electrical ratings and other engineering data are given in Bulletin 28-T-1. Request your copy.

 466E Pantex Mfg. Corp.
- Heaters, Unit.....Grid unit heaters feature trouble-free heating service in the major chemical plants for over 25 years—no maintenance or repairs. Get the full story on Grid unit and blast heaters and radiation. L479 *D. J. Murray Mfg. Co.
- Heating Systems, Dowtherm......Furnishes descriptive information on Dowtherm heating systems for processes requiring precision control of high constant temperatures at low pressures, in Bulletin ID-54-5.

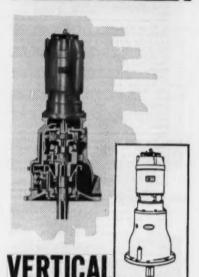
 125 *Foster Wheeler Corp.
- Therme-Panels.....Cost less & perform better—an improvement on pipe colls. You save space & heat or cool more efficiently. For use in heating & cooling of liquids, slurries, soaps, etc. Bulletin 355 & 256.

 BR481 Therme-Panel Div.

6

[•] From advertisement, this issue

Philadelphia MOTOREDUCER



For a compact, neat and sturdy self-contained Vertical Speed Reducer, the Philadelphia MotoReduceR is tops in design, construction and operation. The unique single casing and bolted-on motor construction . . . makes mounting and installation very simple, and of course, it eliminates base plates and couplings. The planetary, in-line reduction gears provide a rugged drive capable of withstanding severe overload conditions . . . Other features are: wide bearing span, permitting use of long, unsupported vertical shafts; Exclusive "dry-well" construction, which prevents oil leaking down output shaft.

Philadelphia MotoReduceRs can be supplied for output speeds from 9 R.P.M. to 420 R.P.M. with standard motor speeds . . . Units up to 100 H.P. are available—and a full range of horizontal units can also be supplied.



For complete information, send for 32 page Catalog MR-54

phillie gear®

PHILADELPHIA GEAR WORKS, INC. ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA. Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS LIMITORQUE VALVE CONTROLS FLUID AGITATORS • FLEXIBLE COUPLINGS

Virginia Gear & Machine Corp. . Lynchburg, Va.

LITERATURE . . .

Towers, Ceeling......Stainless—2—150 tons. Suitable for indoor or outdoor location. Quiet operating. Marlo heat transfer equipment now available to your specifications. Request further information.

Traps, Steam.....Piping diagrams for 22 typical kinds of chemical processing equipment are shown on a chart 11 x 25 inches . . and there are six pages of steam trap selector tables covering 35 types of equipment.

467.A Yarnall-Waring Co.

Traps, Steam.....Request No. 1, 1956 Issue of Armstrong Trap Magazine, together with copy of Armstrong Steam Trap Book containing data on traps plus selection, installation and maintenance recommendations.

56-i "Armstrong Machine Wks.

Instruments & Controls

Amplifiers.....Gives specifications of 60 cycle and 400 cycle magnetic servo amplifiers. Contains application data and circuit diagrams. Offer extreme flexibility, latest circuitry, dual input, etc. See Bulletin 382.

467B Norden-Ketay Corp.

Comparators.....Fully illustrated, 100 p. tells how to use pH and chlorine control for water supplies, process solutions, production processes in 34 basic industries. Also covers complete line of comparators.

1.469

W. A. Taylor & Co.

Controllers, Indicating.....Type 51 indicating controller is an air operated, mercury actuated proportional temperature controller. Temperature ranges from -40°F to 1000°F. For complete details, see Bulletin No. 978. 247e

*A. W. Cash Co.

Centrellers, Recording.....Type 57 recording controller is an air operated temperature controller with mercury, vapor, gas or organic liquid actuation. Temperature ranges from —350°F, to 1200°F. Builetin 980. 247e

*A, W. Cash Co.

Controllers, Temperature.....Offers data on Series 540 indicating temperature controller... uniform sensitivity and close accuracy make it ideal for kilns, ovens, liquid baths, baking ovens. Request Catalog No. 500. *Fenwal, Inc.

Centrols, Level..... New electromagnetic level control—Type 10CB4—for the control of all electrically conductive liquids in the chemical, waterworks, food processing, dairy and sewage fields. Bulletin FF 544a. 4676 Electronics Corp. of America,

Controls, Temperature......Features; cuts initial control costs; costly production stoppages; control maintenance costs. Controls for gas, liquids & solids in —30°F, to 1200°F, ranges. Condensed Catalog CC.
470

Partiow Corp.

Controls, Temperature......Completely illustrated, 16 p. catalog presents company's line of standard locat mounted temperature controls. Includes theory, features, general specifications, etc. Catalog Section 100.

467D United Elec. Controls Co.

Controls, Temperature.....17 p. catalog presents company's line of remote bulb temperature controls ... industrial, aircraft, marine, special purpose. Includes features, specifications, etc. Catalog Section 200.

368 *United Elec. Controls Co.

Detectors, Leak.....Contains latest technical data on Beckman leak detector as well as information on many applications. Locates minute leaks in pressure, vacuum and hermetically sealed systems. Bulletin 482. 467E Beckman Instruments.

* From advertisement, this issue



PLANT LOCATION FACTS

on financial assistance the free enterprise way

Financing a new plant today is a problem for any business, large or small.

In New York State, many banks, insurance companies and investment houses are willing individually to help you in making arrangements to finance new operations or build new plants. In addition, by special charter of the State Legislature, there has been established in the State of New York the New York Business Development Corporation. This organization is privately financed and managed and specifically designed to assist qualified enterprises in financing new or expanded operations in the State.

If you have a financing problem, our business is to put you in touch with the proper sources of capital. Therefore, whether you need mortgage money to help finance your new plant in New York State or working capital to cover expanded operations or to offset expenditures for moving into the State, do not hesitate to get in touch with us.

Financing won't be your only consideration in deciding on a new plant. You will want complete facts on labor, markets, water, available sites or buildings, power, fuel, transportation and raw materials, to mention just a few. And you will want information on these as they apply to the successful operation of a specific plant.

A tailor-made report

Any or all of the factors important to your analysis will be covered in a confidential report to you—tailored to your needs. It will be prepared by a professional and experienced staff to cover either New York State locations of your choice, or, if you wish, sites which we will select on the basis of your needs.

Our booklet, "Industrial Location Services," explains what we can do for you. To get your free copy, write me at the New York State Department of Commerce, Room 659, 112 State Street, Albany 7, New York.

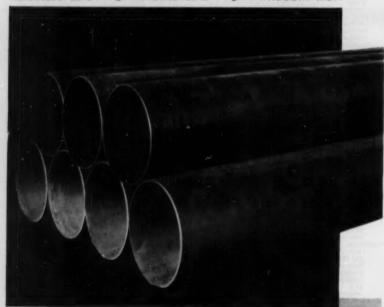
EDWARD T. DECKINSON
COMMISSIONER OF COMMERCE

OSEY LARGE O.D. PI

Posey specializes in the fabrication of large O.D. pipe for high pressure, high temperature service in water lines, sewage outfall lines and similar applications . . . with facilities for producing pipe and piling from 20" diameter and larger . . . economically and on time. Write for specifications and prices without obligation. Your request will receive immediate attention.

CARBON STEEL STAINLESS CLAD STAINLESS STEEL MONEL CLAD

NICKEL CLAD WROUGHT IRON



ELEVATED TANKS

HORIZONTAL TANKS

STACKS

PRESSURE VESSELS

DIGESTERS

CARBON AND ALLOY STEEL PLATE FABRICATION DREDGE PIPE AND ACCESORIES

POSEY IRON WORKS, INC.

Steel Plate Division New York Office: Graybar Building Established 1910

Lancaster, Penna.

LITERATURE . . .

- Gages.....For pressure, vacuum or compound service. There are no gears or teeth to wear out. Cam wiping action keeps contact points clean & smooth. Provides complete information in Gage Catalog No. Gr-2.

 368 "Helicoid Gage Div.
- Gages, Heat-Cooled.......Give accurate liquid level readings, without tracing. Specially designed to carry a circulating medium... heated to speed flow of slow, cold liquids. Request Data Unit No. 237.

 R469a *Jerguson Gage & Valve Co.
- Gages, Liquid Level.....Presents valuable data on liquid level gages: reflex; thru vision; tubular. Standard equipment in leading refineries and industrial plants all over the world. Request complete Catalog.

 R465 Strahman Valves.
- Gages, Vacuum & Pressure.....Hastings principle of noble metal compensated thermoplies offers advantages not found in other gages. Give highest accuracy, stable performance, rapid response, long life. Catalog 140, 468A Hastings-Raydist.
- Indicators, Stabilized pH......Offer these advantages: quick warm-up; fast response; measuring errors "designed out;" only two adjustments; fine performance. Company furnishes detailed information in Data Sheet E-96(2). *Leeds & Northrup.
- Indicators, Temperature.....Model F-1
 is available with maximum visibility
 dial; choice of temperature ranges
 from minus 50°F to plus 750°F; etc.
 Request catalog describing line of indicators & recorders.
 T387
 *Elec. Auto-Lite Co.
- Measurement & Control, Temperature....

 Foxboro offers a wide variety of primary elements, transmission devices, indicators, recorders, and controllers.

 Company makes complete details Company makes complete details available on request. 52-3 *Foxboro Co.
- Meters & Filters.....Control inventory and quality from storage or tank car through plant with meter-printed tickets for accounting of liquids han-died. Catalog contains full details. Available on request. *Bowser, Inc.
- Meters, Power.....Bulletins present fea-tures. applications. description and specifications of RF power meters ...type LP-90 from 20 to 1,000 MC and type LP-91 from 1,000 to 10,000 MC. Bulletins L3005 and L3010. 468B Radio Corp. of America.
- Meters, Volt, Vacuum Tube.....Bulletin presents features, applications, description, specifications and accessories for type LV-10 vacuum tube voltmeter. For details, company makes Catalog L.1010 available on request.

 468C Radio Corp. of America.
- Pyrometers.....Bulletin gives complete information on Bristol Dynamaster pyrometers for your temperature con-trol job, large or small. Company makes complete technical data avail-able as well as Bulletin P1245A. 46-7d *Bristol Co.
- Receivers. Metagraphie Features a new degree of performance, flexibility, & ease of servicing in a pneumatic re-ceiver. Bristol's line gives you 35 models to choose from. Request de-tailed Bulletin. 46-7e *Bristol Co.
- Regulators.....Revised bulletin on Rock-well '1061' Regulators covers: where they are used; how they work; how they are made; how to evaluate per-formance; how to install; operating pressure limits. Bulletin 1059. 468D Rockwell Mfg. Co.
- Regulators, Atmospheric.....Norwalk atmospheric regulators deliver gas to burners at zero pressure and maintain gas-air ratios over a wide range of turn down. For complete details, Request Bul. #6000.

 468E Norwalk Valve Co.

^{*} From advertisement, this issue

TAYLOR COMPARATORS

help you control

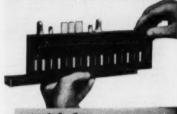
CRYSTALLIZATION

> BLEACHING

PRECIPITATION

EXTRACTION

WASTE TREATMENT



with fast, easy PH and CHLORINE analyses

Handy kits help you control unit operations and waste disposal with fast, accurate colorimetric analyses . . . right on the spot. By Taylor's simple visual methods, you can determine pH, chlorine, bromine, phosphate, QAC, nitrate and metal ions quantitatively in only three easy steps . . . just take your sample, add reagent and read direct after comparing with a standard. Test kits are completely portable for use by plant supervisors and foremen as well as in the laboratory.

GUARANTEED

Taylor liquid color standards carry an unlimited guarantee against fading . . . no danger of mechanical inaccuracy. Each complete set of standards is mounted in a lightweight, durable plastic slide . . . no single standards to handle.

CALL YOUR LABORATORY SUPPLY HOUSE for Toylor sets or write direct for FREE HANDBOOK, "Modern pH and Chlorine Central". Gives theory and application of pH control, Bustrales and describes

full Taylor line.



W. A. TAYLOR AND

LITERATURE . . .

Regulators, Temperature.......Catalog gives complete features, data, dimensions, and specifications for Fulton Sylphon temperature regulators. Offer unmatched service at the lowest cost. Request Catalog RC-D.

68-9 *Fulton Sylphon Div.

Regulators, Temperature, Self Operating
.....Series V Regulator is recommended for steam, water, gases and
fluids not corrosive to brass. Operates
on liquid filled thermostatic system.
Request Bulletin 500.
247a °Cash Standard Stacon.

Resolvers, Precision.....Gives specifications and characteristics of 36 precision resolvers in standard frame sizes—10, 11, 15 and 23. Give accurate solutions to problems encountered. See Bulletin 374. 469A Norden-Ketay Corp.

Scanning & Logging Systems.....Fully
illustrated, 14 p. brochure describes
the Taylor 'Trans Scan Log' control system. Permits quick identification, evaluation & correction of any
process change. Bulletin 98268.
66-7 "Taylor Instrument Cos.

Testing Apparatus, Solia-Asphalt....New 128 p. catalog contains descriptions of over 1350 items of apparatus for engineering tests of solis, concrete asphalt and construction materials. Request Solitest Catalog. 469B

Thermisters.....Catalog gives dimensional drawings, physical descriptions, and complete electrical specifications for various forms of precision thermistors, including beads, rods, discs, washers. See Catalog EMC-1.

469C Fenwal Electronics.

Thermometers..... "Every Angle" design for installation anywhere; antiparallax maxivision dial that practically eliminates the possibility of parallax error; bi-metal actuation for high sensitivity. See Bulletin 148.

Thermometers, Dial.....Ranges, catalog numbers, list prices for American Bi-Metal Dial Thermometers. Type 91 series adapter sets for these thermometers. Features and specifications given in Bulletin No. 149.

469D Manning, Maxwell & Moore.

Transformers, Variable..... Bulletin covers connections, motor drives, Fowerstat type 20, types 116-216, types 1126-1226, types 1156-1256, oil-cooled models, explosion-proof models, line correctors, etc. Bulletin P550.

469E Superior Elec. Co.

Pipe, Fittings, Valves

Elbows, Reducing.....Offer important advantages in both piping design & piping cost. Need only 2 welds instead of the 3 required by a standard elbow & a reducer. For full details, request Catalog No. 54.

*Midwest Piping Co.

Fittings, Forged Steel.....28 p. catalog on forged steel pipe fittings contains complete dimensional, engineering and application data on forged screw-end and socket-welding fittings for high pressure service. Bulletin A-3-56. 469F H. K. Porter Co.

Fittings, Stainless Steel.....New stainless steel fittings will assure you of long, trouble-free service in tough piping applications , will reduce down-time and cut maintenance costs, Bulletin No. S-3-55.

390

*Watson-Stillman Fittings.

Fittings, Stainless Steel.....Speedline fittings simplify pipeline design. Details of the greater design flexibility possible with Speedline fittings ... at lower cost . . available in new fully illustrated catalog.

TR481 "Horace T. Potts Co.

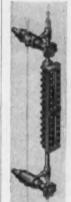
• From advertisement, this issue

How to Solve Problems of ACCURATE GAGING

of levels and pressures when liquids are

COLD and SLOW or HOT and FAST

Whether you handle liquids whose flow is "slow as cold molasses," or which boil and surge so they're hard to gage, Jerguson can solve your problems of accurate liquid level and pressure gaging.



Jerguson Heated or Cooled Gages

Specially designed to carry a circulating medium . . . heated to speed up the flow of slow, cold liquids . . . cooled to slow down boiling or surging liquids. Give you accurate liquid level readings, without tracing.

Jerguson Heated or Cooled Valves for Pressure Gages



Jacketed design with built-in tracing. Cold, heavy liquids flow so you get accurate pressure readings. Special design reduces threaded connections; combines unions, nipples, etc. in one compact unit. Ideal for cold services, waxes and other heavy materials.

Jerguson Gages and Valves now available with Electric Heating. Ask for special details.

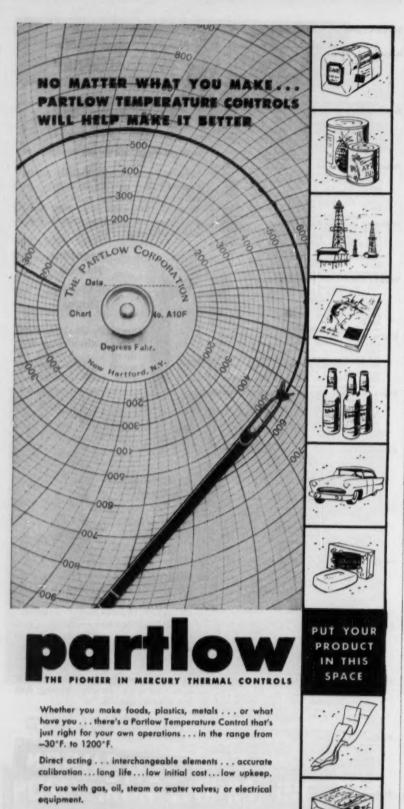
Write for Data Units: #237 on Heat-Cooled Gages; #252 on Valves for Pressure Gages, etc.

JERGUSON

Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY 100 Fellsway, Somerville 45, Mass.

Offices in Major Cities Jerguson Tress Gage & Vaive Co., Ltd., Lendon, Eng. Pétrole Service, Paris, France



SEND FOR CONDENSED CATALOG

THE PARTLOW CORP., Dopt. E-96, NEW HARTFORD, N.Y.
Offices in All Principal Cities

LITERATURE . . .

Giands, Thermocouple.....Multiple wire thermocouple glands provide easy entrance into pressure vessels of 1, 2, 4, 6 or 8 wires by method of scaling bare wires at pressures from full vacuum to 20,000 psi. Catalog 1556.

476A Conax Corp.

Joints & Couplings.....Tefion expansion joints and flexible couplings absorb shock, vibration, thermal expansion and contraction. Connect unlike piping ends and nozzles. Covers complete data in Bulletin EJ-1155.

378b *U. S. Gasket Co.

Mountings, Cylinder.....Mountings are simple and provide positive protection against breakage due to misalignment. Bulletin illustrates the use of these mountings and gives dimensions. See Bulletin No. 76. 476B Hanna Engrg. Wks.

Packings, Valve Stem.....Describes 2 general types in which they are available (braided of asbestos yarns, and plastic), manner in which they are made and illustrates shapes most commonly used. Bulletin 6905.

470C Raybestos-Manhattan.

Pipe & Fittings.....For corrosion-resistant piping. Impervious graphite pipe & fittings readily installed, long lasting, easily maintained, unaffected by most corrosive fluids. Catalog Section No. S-7000. *National Carbon Co.

Pipe, Plastic.....Polyvinyl Chloride is the unparalleled material for plastic pipe. It's a high quality unplasticizedrigid pipe designed to do a better job than any other material. The full story in Bulletin 24. *U. S. Steel Corp.

Pipe, Plastie..... General-purpose moderately priced rubber-plastic pipe handles most common chemicals to 170° F... except few strong acids & organic solvents. Tough, odorless, tasteless, Bulletin No. 80.

372e *American Hard Rubber Co.

Pipe, Pressure......"How to Install Johns-Manville Transite Pressure Pipe for Overhead Industrial Water and Process Lines," is the title of a new 48 p. guide issued by Johns-Manville. Request your copy.

4700 Johns-Manville.

Pipe, Saran Lined Saran lined pipe, fittings and valves cut corrosion costs . . can be cut in the field with available pipe fitter's tools. Liquid never touches metal in saran lined pipe. Request details.

30 *Saran Lined Pipe Co.

Pipe, Steam Traced.....Report savings of up to 30% in labor cost, plus important reductions in material and insulation costs. More detailed information on applications and methods of using Unitrace in Builetin AD418. 293-300e *Aluminum Co. of America.

Tubing, Alloy Steel.....Folder includes condensed data on carburizing and thermal treatments, critical points, mechanical properties and suggestions on welding and machining of these steels. Request Folder TDC-184.

470E Babcock & Wilcox Co.

Tubing, Carbon Steel......Furnishes condensed data on mechanical and physical properties of seamless and welded carbon steel pressure tubing and suppiles information on various fabricating operations. Folder TDC-142A. 470F Babcock & Wilcox Co.

Tubing & Pipe, Stainless..... Carpenter stainless tubing & pipe have proven their ability to stand up under increased temperatures & thruput, with cost reductions in material, labor, etc. "Selecting & Buying Guide"

346 *Carpenter Steel Co.

Unions & Valves..... Catalog contains up-to-date engineering data specifications and prices on complete line of hot forged steel products. Covers Catawissa perfect seal pipe unions and swing check valves, Catalog 56, 4766 Catawissa Valve & Fittings.

3

• From advertisement, this issue

Molded Hard Rubber proves best for....



Another Corrosion Problem Solved by Luzerne

Above is shown a portion of a typical cell in Western Electric's Electroforming plant at their Point Breeze Works. This cell consists of a plastic lined metal shell with hard rubber weir plates fastened to each end. The feed weir shown is cored and connected to the electrolyte supply line by a flexible elbow.

Western Electric reports that a number of materials were considered for fabrication of these weirs and flexible elbows and it was concluded that hard rubber and neoprene provided the best combination of temperature stability, corrosion resistance, mechanical strength, ease of fabrication, and moderate cost.

Luzerne fabricates these hard rubber parts for Western Electric; they can solve your corrosion problem too. Write for information on Hard Rubber Molded Products, or send your problem for analysis by our engineering department.



The LUZERNE RUBBER CO.

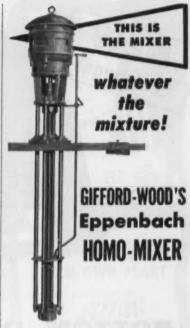
LITERATURE . . .

- Valves.....Features: non-sticking; no metal-to-metal contact; needs no lubrication; requires no packing; renewable sleeve & plug. Details on type F valves are available. Request a copy of Bulletin V/4a.
- Valves..... "Sentry" Models 1200, 1700 & 1800, & 3000 are patented quick-closing latch type & quick-opening piston type. All are full flow valves. Sizes run from 1½ to a full 8 in. For full information request Bulletin 500. 287 *Coppus Engineering Corp.
- Valves..... "Equa-Safe" valve manifolds stop mercury blowing, damage to differential bellows & diaphragma. Entire story on what these valves can do for your differential instrument installations in Bulletin 56-1. 312 "Republic Flow Meters Co.
- Valves.....There's an Ace hard rubber, rubber-lined, or plastic-lined valve for every corrosion application. Sizes from 2" to 24". Diaphragm gate and check types. Lists chemicals handled in Bulletin CE-52.

 373a *American Hard Rubber Co.
- Valves, Butterfly.....In this new Catalog you get the complete dimensions, layout drawings, specifications and materials for all pressure ratings of R-S Butterfly Valves that are now standardized. Catalog 160, 386 *S. Morgan Smith Co.
- Valves, Check.....Norwalk diaphragm type check valves, both horizontal and vertical, provide positive check against reverse flow of either gas or air. Prevent flow of air into gas lines. Request Bulletin No. 2000. 471A Norwalk Valve Co.
- Valves, Control.....Two-way directional control valves for fluid power systems up to 3000 pai are described in 16 p. bulletin. Includes details of valve body construction and functions of plungers. Request Bulletin 80200.

 471B Oligear Co.
- Valves, Control, Diaphragm.....Type 30
 diaphragm control valve is rugged
 and dependable. Available in sizes ½"
 to 12" with various styles of inner
 valves—reverse or direct acting.
 Request Bulletin No. 980.
 347d *A. W. Cash Co.
- Valves, Diaphragm.....Describes Grinnel-Saunders diaphragm valve with straight-through flow. Includes advantages, maintenance, design, selection of bodies and bonnets, etc. Fully illustrated, 4 p. *Grinnell Co.
- Valves, Diaphragm, Packless.....Eliminate stem leakage and maintenance on air, vacuum, gas, light oil and similar services. Available in wide selection of materials and sizes. For details, request product bulletin. 333-4 *Crane Co.
- Valves, Fittings & Piping, Jacketed..... Useful information for designers, engineers, plant superintendents, maintenance men, and all others who specify, use, or purchase jacketed piping, valves & fittings. Catalog 356. 4710
- Valves, Float.....No. 60 Float Valve—
 globe or angle—for many different
 services, simple in construction,
 accurate in operation. Has single
 seat, pilot stem. For further information, see Bulletin 101B.
 L475b *Davis Regulator Co.
- Valves, Forged Steel.....Advantages of bonnetiess valves are: simplicity of design; fewer parts; elimination of stud, nut and union corrosion; lower maintenance cost; more safety. For details, see Catalog No. 700, 471D Velan Steam Specialties.
- Valves, Hydraulie Bulletin presents object, applications, operation, specifications, prices, mounting dimensions, and ordering instructions for Type 555-RO four way hydraulic valves. Request Bulletin 8-600, 471E

* From advertisement, this issue



A high speed, high shear homogenizermixer for complete, "no-vortex" mixing of chemicals, cosmetics and pharmaceuticals to produce emulsions of small particle size and long shelf life.

Check these features:

- Continuously draws material from the bottom of the tank, thus eliminating a vortex and minimizing air intake.
- Easily adjustable deflector plate to control flow pattern.
- Stationary or portable operation.
- Homogenizing head dismantles easily for cleaning.
- All immersed parts of stainless steel.
- Can be modified to suit existing processing requirements.
- Capacity governed by viscosity, specific gravity and batch size.
- · Laboratory and production sizes.

Eppenbach Catalog No. 402R-2 describing HOMO-MIXER Models and accessories. Write for it. Also ask about the famous Eppenbach Colloid Mills and Agi Mixers and G-W Chemical Feeders and Breakers.

GIFFORD-WOOD CO.

GIFFORD-WOOD Eppenbach Divi 420 Lexington Aver	
Send me Catale HOMO-MIXERS.	og 402R-2 describing
Nome	
Title	
Company	
Address	
City	State @ 2620



Plus CENTER-SLUNG SUSPENSION . . .

unloads fast This new Tolhurst Batch-Master Centrifugal discharges solids through the bottom in seconds . . . saves unloading time . . . speeds up production cycles. In fact, it's the fastest unloading centrifugal there is. The bottom opening is 25% larger than on any other machine.

sandies unbalanced loads Batch-Master is constructed with Tolhurst's exclusive "Center-Slung" design. The points of suspension on the case are in a plane which passes through the center of gravity of the rotating basket and load. This reduces the overturning effects of unbalanced loads and allows the rotating mass to find its own center of gyration. Thus "Center-Slung" centrifugals handle 3 to 4 times greater out-of-balance loads than ordinary machines. So Batch-Master runs smoothly — with vibration largely eliminated, bearing stress relieved.

Sizes are 40" and 48" . . . in choice of corrosion-resistant materials . . . perforate or imperforate baskets. Send for full data.

Tolhui	ST CENTRIFUGALS
American	Machine and Metals, Inc.
	-956 EAST MOLINE, ILLINOIS
NAME AND TITLE	
ADDRESS	

LITERATURE

- Valves & Joints..... Wheaton bulk handling & truck tank equipment enjoys a world-wide reputation for performance "plus" wherever liquids are handled in volume. Complete product catalogs are available upon request.

 263 *Wheaton Brass Wks.
- Valves, Pressure Gage..... Ideal for cold services, waxes and other heavy materials. Special design reduces threaded connections; combines unions, nippies, etc. in one compact unit. Request Data Unit No. 252. R469b *Jerguson Gage & Valve Co.
- Valves, Regulator, Temperature & Pressure.....OPW-Jordan valve, with the sliding gate, specifically designed to overcome wire drawing, valve leakage, poor control, chatter, excessive maintenance. See Bulletin J-90.

 18 *Jordan Corp.
- Valves, Solenoid......Choose rugged industrial type Davis solenoid valves ... for less downtime—less maintenance—more reliable control. For complete details of features, request copy of Bulletin 700.

 1475a *Davis Regulator Co.
- Valves, Selenoid.....Latest designs in ASCO's line of 2, 3 and 4 way solenoid valves included in condensed catalog. Contains engineering information, flow charts, operation and construction details. Catalog 201. 472A Automatic Switch Co.
- Valves, V-Port & Solid Turned..... Use
 Point 4 Factor Trim where reduced
 capacity trim is required. Available
 in V-port & solid turned designs for
 double or single seated valves.
 Request Data Sheet 10-5.
 44-5

Process Equipment

- Absorbers.....For absorption of hydrogen chloride and other gases. Produce as much as 20 tons per day 22° Baume acid. Pneumatic automatic information in Catalog Section No. 3-7460.

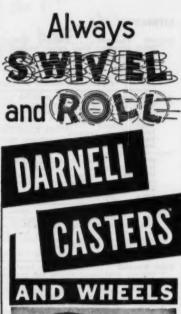
 233g *National Carbon Co.
- Agitating Equipment.....Use Nettco Flomix to combine liquids & solids as they flow through a pipe line. For complete information, company makes available bulletins & data. Bulletin Nos. 531, 551 & 532. 104 "New England Tank & Tower.
- Autoclaves.....Blaw-Knox autoclaves furnished in a size and type for every pressure and temperature application with all auxiliary equipment, when desired, for a complete high pressure plant. See Catalog 2413-R. 168 **Blaw-Knox Co.
- Bienders, Spiral..... New Catalog gives exact specifications in light, medium and heavy duty blenders offered, plus information on special order design and service. Points out money-saving & time-saving improvements.

 383 "American Weided Tank & Machy.
- Centrifugals......A Reinveld Centrifugal can reduce your Thermal Dryer requirements as much as 64% over conventional filtration methods. Capable of handling 1200 gallons per hour of feed siurry. Bulletin RC356.
- Centrifugals, Continuous B-P S Size
 48 continuous Centrifugals are designed for centrifuging relatively freedraining crystalline, granular &
 fibrous materials. Catalog describes
 Types S, HS, & HF.

 Baker Perkins.
- Centrifugals.....When your process calls for liquid-solids separation by centrifugal force...you can do it more economically with the new Tolhurst Center-Slung centrifugal. Reguest Bulletin TC-14-55. 472 *Tolhurst Centrifugals Div.

13

[•] From advertisement, this issue





Note these features:

RUBBER TREADS . . . a wide choice of treads suited to all types of floors, including Darnelloprene oil, water and chemical-resistant treads, make Darnell Casters and Wheels highly adapted to rough usage.

RUST-PROOFED . . . by zinc plating, Darnell Casters give longer, care-free life wherever water, steam and corroding chemicals are freely used.

LUBRICATION . . . all swivel and wheel bearings are factory packed with a high quality grease that "stands up" under attack by heat and water. Zerk fittings are provided for quick grease-gun lubrication.

STRING GUARDS . . . Even though string and ravelings may wind around the hub, these string guards insure easy rolling at all times.

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Gree Darnell Manual

DARNELL CORPORATION.

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LITERATURE . .

Cleaning Systems, Vacuum....The Lamson Exidust central vacuum cleaning system for every industrial and commercial cleaning need is discussed in bulletin covering operating and design features. Bulletin E-6. 472B Lamson Corp.

Classifiers..... Sharples super classifier with ultra-sharp cutpoint at high capacity for classifying dry powders gives product recovery of 80% to well over 90%. For details on outstanding features, request Bulletin 1280.

133 *Sharples Corp.

Classifiers.....All classifiers (Rake Type, Spiral, Hydro, are designed to efficiently separate fine particles in specific applications. For complete information on company's line, request Bulletin C5C-B.

391e Denver Equipment Co.

Orashers, Gyratory....."One-man, oneminute" product control, a feature of Allis-Chalmers primary, secondary & tertiary gyratory crushers, cuts setting changing time from hours to seconds. Request literature. 85-46b "Allis-Chalmers Mfg. Co.

Creshers, Jaw..... Eight models; range from 2 x 6 in. jaw opening to 12 x 26 in. Capacities to 30 tph. All except two smaller sizes operate on double cam principle-crush twice per energy unit. Request Bulletin No. 062.
2826 *Sturtevant Mill Co.

Crushers, Jaw.....Cast, steel frame, manganese jaw & check plates. Large diameter shafts reduce shaft deflection & thus increase life of heavyduty oversize roller bearings in bumper, Bulletin No. C12-B12.

391d *Denver Equipment Co.

Crushers, Rotary Fine.....Five models available. Reduce 3 to 8 in. material to ½ to ½ in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 20 in. Request Eulletin No. 663.

282a *Sturtevant Mill Co.

Dissolvers.....Speeds on new Cowles
Model 1-VG are variable from 1960
rpm to 5900 rpm (with impeller
speeds of 1600 to 6150 fpm depending
upon the size impeller used). Complete information available on request.
473A Morehouse Cowles.

Dryer-Coolers, Rotary.....This versatile equipment is particularly applicable in drying or cooling heavy or high moisture content materials. Dries with parallel flow and cools with counterflow. Request data.

35-40h **Allis-Chalmers Mfg. Co.

Dryers..... Hein solve problems of drying air or other gases. Offer valuable advantaces: simplicity of operation & maintenance; low installation cost & minimum maintenance expense. Details in Bulletin D-29. 86 °C. M. Kemp Mfg. Co.

Dryers..... Available in several types:
direct heat, indirect heat, and steam
tube. Let Deco ensineers help solve
your drying problem—no dryer problem too small or too large. Details in
Bulletin No. D4-B2.
391j

Dryers.....Full line pressure reactivation, purging eliminated, longer absorbent life, no moving parts, simple design, all air or gas entering dried without loss. Complete details in Bulletin 16.0.018.

403

403

Pritchard & Co.

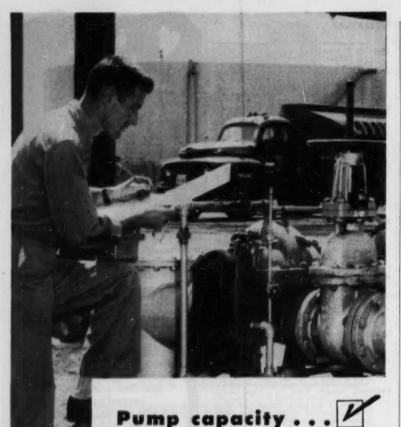
Dryers, Rotary.....Deliver top production. exacting performance, greater profits. Tells how Standard-Hersey has aided manufacturers throughout the world in solving their dryer problems in illustrated 12 p. Bulletin. 137. *Standard Steel Corp.

Dryers, Botary.....The Davenport rotary hot air dryer is of stainless steel construction. Dryer is installed in one of the large processing plants, drying wheat gluten. For complete details, request Catalog "A."

B487 *Davenport Mach. & Foundry.

* From advertisement, this issue





If it's capacity you want, check the Goulds Fig. 3405

single-stage suction pump. You'll get capacity all right-and much more!

You can pump at any rate from 200 GPM to 6400 GPM with one of the 19 available sizes. And you can save money, too, because of these built-in cost advantages:

interchangeability of parts—Only three shaft and rotating-parts assemblies provide for 19 pump sizes and 38 pump combinations.

Standard "custom" features—Every Fig. 3405 pump has sealed bearing housings, renewable stuffing box bushings, Teffon water seal rings, stainless steel im-peller keys, cowl-type glands, die-formed stuffing box packing, and corrosion-resistant gland bolts.

Compact construction - Short bearing spans cut pump lengths as much as 50 percent—which means less floor space.

Flexibility of stuffing box — You can change from conventional stuffing boxes to mechanical seals in the field.

Easy rotation change — Its unique design permits

you to change the direction of rotation in the field. When you check *capacity*, you'll find it in a Goulds Fig. 3405—and more besides. Call your Goulds representative or drop us a card. Ask for Bulletin No. 721.6.



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LITERATURE . . .

- Dryers, Vacuum.....Faster, uniform heat transfer plus rapid vapor removal . . means today's best in vacuum drying with the Patterson Conaform. For complete product data, request new detailed Bulletin. 368 Patterson Foundry & Mach.
- Dust Collectors.....New Pangborn Ven-trijet gives efficient wet dust control. Complete self-contained unit with low headroom, minimum floor space. Com-pany makes further information available on request. 366 *Pangborn Corp.
- Dust Collectors.....New Ventrijet for the wet collection of industrial dusts is illustrated and described in \$ p. brochure. Dimensions, weights and capacities are presented in 3 tables. For details, see Bulletin \$20. 474A Pangborn Corp.
- Dust Collectors......Cyclo-trell operates
 on centrifugal collection principles
 and incorporates new design features
 to boost collection efficiency and gas
 handling capacity. "Cyclo-trell Multiple Tube Dust Collector."
 474B Research-Cottrell.
- Dust Control.....Analyses of how dust control equipment solves the problem of recovering valuable dusts—or con-trolling harmful dusts. Makes avail-able Bulletin covering complete tech-nical information. No. 809. 41
- Dust Control.....Sly flat bag dust filters get all the dust. Pioneers and leaders in industrial dust control, they have a complete range of equipment for all process operations. Request Dynaclone Booklet.

 *W. W. Sly Mfg. Co.
- Dust Filters......28 p. book explains in detail the distinguishing features of reverse jet filters. Contains schematic operating diagrams, performance curves for various types of dust. Request Bulletin No. 559.

 4740 Day Co.
- Filter Fabrics.....The right fabric adds
 efficiency to continuous operation.
 Announces availability of a fully
 illustrated booklet, "Filter Fabric
 Facts," describing filter fabric development and application.
 316
- Filter Leaf.... New "RIM-LOK" Filter Leaf provides simple closure of metal filter cloth in leaf frame without use of rivets, bolts or solder. Made of any commercial alloy. RIM-LOK Bulletin on request. on request.

 T489 *Multi-Metal Wire Cloth Co.
- Filter Paper.....The use of E&D filter paper as a cover may be indicated if your filter medium is blinding or clogging. Will recommend proper grade for use and send samples for testing. "Filtration Analysis Report."

 B486 **Eaton-Dikeman Co.
- Filters......Special bulletin describes LPD oil bath filter; listing sizes, capacities and pressure drops; explaining selection of correct filter size; and detailing simple servicing procedure. Request your copy.

 474D Air-Maze Corp.
- Filters, Air, Electronic.... Bulletin tells how electronic air filters cut office building maintenance costs \$18,000 a year. "The New England Life Electro-Matic Story" gives details. Request Bulletin 250-A-1.
 474E American Air Filter Co.
- Filters, Disc..... Special patented design of segments in filters use both gravity & vacuum to give a drier filter cake. Drainage is complete & positive with no blow-back. Details contained in Bulletin F9-B2.

 301f *Denver Equipment Co.
- Filters, Gas.....Norwalk gas filter removes all fine dust and scale from gas as it passes through the filter. Reduces service calls and pilot light outages. For further information, request Bulletin No. 9200.

 474F Norwalk Valve Co.

13

^{*} From advertisement, this issue

VALVE SPECIALTIES FOR STEAM, AIR

OR GAS

Davis offers a complete line of valve specialties including relief valves, altitude valves, pump governors, pressure regulators and emergency valves. No matter what the control problem, there's a Davis specialty product to meet the need. Contact Davis today for precision control valves.



SOLENOID VALVE Heavy duty, durable valve that will handle the toughest jobs. For viscous fluids, resins, syrups, varnishes as well assteam, water, plosion proof, renewable disc, visible action, emergency manual operation.

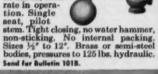
tion, emergency manual operation.

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ad for Bulletin 700.

No. 60 FLOAT VALVE

A valve for many different services, simple in con-struction, accurate in opera-tion. Single



PACKLESS FLOAT BOX

For handling volatile or flammable fluids. flammable fluids.
Leakproof, packless, thanks
to Davis Dia-Ball unit (see below).
Sealed, flexible joint, minimum maintenance, higher sensitivity, less friction. Operates control valves from ½" to 8". Float sizes—6", 8" or 10". Pressures to 250 psi. Temperatures to 300° F. Write for Bulletin.



DAVIS DIA-BALL TRANSMISSION

Packless diaphragm ball transmission arm for Davis level controls, float bozes and lever units. Patented, leak-proof construction. Eliminates fric-tion, accurate transmission, mini-mizes maintenance due to packing, less hazardous for flammable fluids because of leakproof feature.

Write for details.

SEND FOR COMPLETE FILE OF LITERATURE



Chicago 8, Illinois 2939 So. Washtonaw .

LITERATURE . . .

Fiters, Liquid.....Company offers 12 pg. bulletin describing its Staynew fiter. Contains engineering & performance data, photos, descriptions of fitering media, recommended use of each, etc. Request Bulletin 300. 318 *Dollinger Corp.

Filters, Vacuum.....Tilting pan vacuum filters will prove useful when you have coarse, heavy solids; when you solids tend to blind filter cloths; when you need best wash, with minimum wash water. Request Bulletin.

6 *Bird Mach. Co.

Filters, Vacuum, Continuous Betary.....
All types—string, horizontal, scraper, precoat, etc.—are custom designed & manufactured. Give trouble-free operation & greater efficiency at lower cost. Request bulletin.
279
*Filtration Engineers.

Filters, Water.....12 p., fully illustrated bulletin completely describes uses, design features and engineering details of pressure sand and gravel filters. Details on all accessory equipment. Full information in Bul. WC-107A.

475A Graver Water Conditioning.

Filtration Equipment..... Sperry makes available a catalog complete with charts, tables, & diagrams to help in the operation, maintenance & selection of filtration equipment. Request your copy. Catalog 7-E.

410

**O. R. Sperry & Co.

Floats.....Harris Floats for any liquid, for high pressures, for high temperatures. Catalog presents data on various sizes, types of floats, and suitable metals for different corrosive liquids, temperatures.

*Arthur Harris & Co.

Flotation Units..... Design data on Gibbs flotation unit. Booklet tells how the Gibbs flotation unit works; details features; presents schematic flow diagram and specifications. Request this Design Data pamphlet.

475B F. S. Gibbs, Inc.

Generators, Pulse..... Bulletin presents information on features, applications, specifications and description of type LG-30 pulse generator. For com-plete details, company makes Catalog L4650 available on request. 4750 Radio Corp. of America.

Homogenizer-Mixers......High speed, high shear homogenizer-mixer for "novortex" mixing of chemicals and pharmaceuticals to produce emulsions of small particle size and long shelf life. Catalog 402R-2. R471

Homogenizers......Gaulin Homogenizers will stop separation, accent taste & color, improve texture, flow iubricity, speed chemical reactions & dispersion of ingredients & reduce amount of expensive material needed. Request literature.

*Manton-Gaulin Mfg. Co.

Impactors.....Offer lowest possible cost-per-ton in producing top quality mate-rials from 2" down to 35 mesh with a minimum of fines—or much smaller where more friable products are han-dled. Detailed literature. 91 "Williams Patent Crusher.

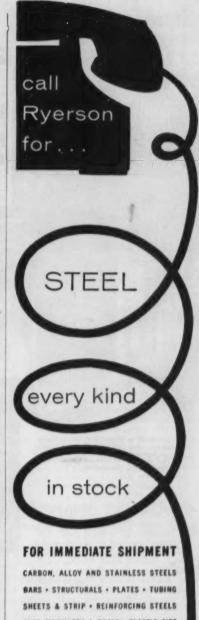
Kiins, Rotary.....efficient thermo-processing of products. Used in the production of lime, bauxie, coment, sodium silicate, alumina, etc. Complete data on design features offered in liustrated Builetin 1115.

41 *Traylor Engrg. Mfg. Co.

* From advertisement, this issue

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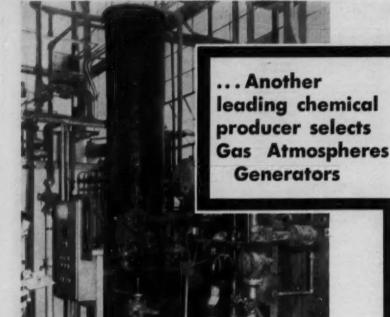
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3000 cfh Nitrogen Generator, above, and 6000 cfh Inert Genera-tor, below, built by Gas Atmospheres for Archer Daniels Midland's Ashtabula, Ohio plant.

Archer - Daniels - Midland uses both nitrogen and inert in fatty alchohol production

> Archer-Daniels-Midland manufactures fatty alcohols, they market under the trade names Adol and Unadol for use in the Adol and Unadol for use in the manufacture of cosmetics and plasticizers, detergents and chemicals. As is true in the manufacture of many chemicals, Adol and Unadol must be processed under oxygen free conditions. To achieve these conditions in the most economical manner possible, Archer-Daniels-Midland, like most chemical processers, decided to make their own gas with Gas Atmospheres'
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> Gas Generating

Gas Generating

Equipment. For processing, they selected a Gas Atmospheres 3000 cfh Nitrogen Dry Gas unit. For blowing out lines and blanketing the finished product, they chose a Gas Atmospheres 6000 ofh Inert Gas Generator.

When it comes to designing gas generation equipment for the chemical industry, processers know their one dependable source is Gas Atmospheres. The result: Gas Atmospheres' units can be found operating successfully in more than 50 percent of the major chemical plants where gas is required in good quantity.

olyment for producing Industrial your

LITERATURE . . .

Kilns, Rotary.....Offers these improvements: all welded; one-plate-to-acircle construction; patented heat recuperation; effective air seals; centralized control; air-cooled feed and discharge ends. Details.

35-40g *Ailis-Chalmers Mfg. Co.

s.....Raymond IMP Mill with flash drying accessories and new type pack-age furnace, solves many production problems in the chemical and proces-sing fields. For full details, request Catalog No. 77.

360 *Combustion Engineering.

Mills, Ball.....A steel-head ball mill will suit your particular need. Five types of discharge trunnions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Bulletin No. B2-B13.

391b *Denver Equipment Co.

Mills, Ball & Pebble..... Valuable references give complete details on the Abbe Engineering series of mills for every range of work from small batch jobs to full scale plant production. Catalog Nos. 73 & 77.

406 *Abbe Engrg. Co.

Mills, Blade..... Designed for large ton-nages of hard-to-wash materials, blade mills effectively disintegrate & wash into suspension tenacious clays and other unwanted substances. Re-quest complete details. 35-40e *Allis-Chalmers Mfg. Co.

Mills, Compacting..... Used to produce paper-thin flakes or to increase the apparent density of your product. Mills handle a variety of grinding, crushing, rolling or compacting jobs. Details available on request.

35-46j *Allis-Chalmers Mfg. Co.

Mills, Grinding.....Allis-Chalmers can meet your specifications whether your process calls for individual mills or a grouped stage grinding series. Request details on 7 different types of grinding mills.

Allis-Chalmers Mfg. Co.

Mills, Hammer.....Reduce to 20 mesh.
Swing-Sledge mills crush moderately
hard material up to 70 tph. HingedHammer pulverizers crush softer material up to 30 tph. For complete information, request Builetin No. 084.
2824 *Sturtevant Mill Co.

Mills, Ring Roll.....Reduce hard or soft 1% in. & smaller material to from 6 to 200 mesh. Grind only—no screens. Capacities of three models range up to 18 tph, depending on model & mate-rial. Request Bulletin No. 079. 282e

Mills, Tube.....For wet grinding ...
titanium pigments, manganese dioxide, diatomaceous earth, limestone;
for dry grinding ... fillers, silica
flour, gypsum, carbon black, pigments,
cement materials. Bul. 18-B-11.
457

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to de-velop a complete technical descrip-tion of agitation required for your process. quickly & easily. No. B-107, 127h

Mixers..... Describes Super Agitators & Mixers. Patented standpipe around propeller shaft assures positive agitation & circulation. Patented wearing plate prevents sand-up on shut-down. Bulletin No. A2-B4.

391a Denver Equipment Co.

* From advertisement, this issue

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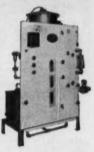
EQUIPMENT



"PACKAGED" DE-IONIZERS

Right, standardized Model MB Mixed-Bed Delonizer available in four sizes for maximum flow rates ranging from 150 to 1000 gals, per hr.





Left, typical Model LU or HB Two-Bed De-lonizer, each series made in six sizes covering maximum flaw rates ranging from 150 to 1000 gats. per hr.

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LITERATURE . . .

Mixers.....Philadelphia Fluid Mixers offer more horsepower capacity per dollar & are easier to install & less expensive to service. Perform smoothly & economically. For complete story Bulletin A-156.

292 *Philadelphia Gear Works.

Mixers, Pertable.....Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. Bulletin B-108.

*Mixing Equipment Co.

Mixers, Side Entering.....Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc., in completely illustrated Catalog E-104. 127d *Mixing Equipment Co.

Mixers, Top Entering.... Makes available pertinent information on topentering mixers (propeller type)... for closed tanks, pressure & vacuum... for open & loose-covered tanks. Data in Catalog No. B-103.

127b "Mixing Equipment Co.

Presses, Filter.....Offer numerous features: lowest cost per sq. ft. of filtering area; produces perfect clarity of filtrate; can be used in decolorizing deororizing; etc. Request illustrated Catalog No. 55.

*T. Shriver & Co.

Presses, Wax Molding.....Press cools and molds paraffin or natural wax, or other substances, into multiple cakes of uniform size, weight and appearance, without shrinkage. For complete details, request Bulletin 127. 384e

Process Equipment.....Large scale and special purpose process equipment for the chemical textile, plastic, rubber and allied industries is described in new brochure. Design and construction details given. Bulletin 236.

477A

Dravo-Corp.

Process Equipment.....Dry blending and heat transfer equipment for the Chemical and Process industries is described in revised, enlarged catalog. Information on new Liquid-Feed Twin-Shell blender. Catalog 14. 477B Patterson-Keiley Co.

Process Equipment..... \$2 p. bulletin covers all Allis-Chalmers equipment for the process industries. This bulletin, as well as literature covering specific equipment lines, is available. Bulletin 25C6177.
35-46a *Allis-Chalmers Mfg. Co.

Process Equipment....Corrosion proof chemical equipment—from piping to complete plant—engineered and constructed to your specific requirements. Knight products and materials covered completely in Bulletin 11-U. 447C Maurice A. Knight

Proportioners & Bienders..... Eliminate costly batching with closed system compounding of liquid components. Accuracy yields uniform, controlled product. For further information, request product catalog.

B482b **Bowser, Inc.

Pulverizers.....The new Mikro-Multi-D pulverizer has been designed for any processing system in which purity of the product is of prime importance. Request a copy of Mikro-D Bulletin & Test Grinding Data Sheet. 163 *Pulverizing Mach. Div.

Renctors, Chamber.....Reacter polymerizes plastic resins at controlled rate of heating and cooling to produce multiple slabs of finished product of any desired size, 12" to 56" square, from 1" to 5" thick. Bulletin 142.

3846 "T. Shriver & Co.

* From advertisement, this issue

COMPLETE RANGE OF SIZES AND MODELS IN BOTH MEDIUM AND HIGH PRESSURE TYPES

MORE COMPACT THAN EVER . .



P-952-A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-E32H size No. 25 unit.

NATIONAL AIROIL

FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compacts, spacesaving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40—very interesting and informative.

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AUTOMATIC OIL BURNERS, for small process for meets and healing plants
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LITERATURE . . .

- Reactors, Continuous.....Votator con-tinuous reactor controls heat of re-action for processing viscous and heat sensitive materials. Key to efficient, low-cost operation is rapid heat transfer rate. Request further data.
- Reactors, Glassed Steel.....Offer a wide range of sizes . . . 5 to 4,000 gals.; several ways to adapt top-head open-ings, agritators, seals, and valves in meeting changing temperature and pressure requirements. Bul. 936. 496 *Pfaudler Co.
- Rolls, Crushing..... Beduce soft to hard 2 in. & smaller material to from 12 to 20 mesh with minimum fines. Eight sizes: rates to 87 tph. Three types available: Balanced, Plain Balanced, & Laboratory Rolls. Bulletin 065. 282e *Sturtevant Mill Co.
- Screens, Gyratory.....All-metal unit is designed to separate dry granular materials into two, three and four predetermined sizes. Request further information on Allis-Chalmers gyratory screens.

 35-461 *Allis-Chalmers Mfg. Co.
- Screens, Vibrating.....Allis-Chalmers vibrating screens are built in single and multiple-deck models for use in scalping, wet or dry sixing, washing, rinsing, dewatering, and media recovery. Details on request.

 35-40d *Allis-Chalmers Mfg. Co.
- Serubbers, Gas.....Installations of this equipment successfully handle difficult gas acrubbing problems. Help stop air pollution and recover valuable materials. World-wide usage. Fulletins M-102 & M-103.

 101 *Chemical Construction Corp.
- Separators, Drum.....4 p. brochure de-scribes improved line of Hi-Powr per-manent, non-electric magnetic Drum Separators. Automatic removal of un-wanted iron from chemicals, food, grain, plastics, etc. Bul. B64-1. 478A Eries Mfg. Co.
- Separators, Entrainment.....For complete liquid-vapor separation use Metex Mist Eliminators ... in vertical tube evaporators, packed columns, distillation columns. For complete details, request Bulletin ME-6.

 341 *Metal Textile Corp.
- Snubbers.....Stops noise from intake & exhaust of air, etc. & stops pulsation caused by line surges from compressors, pumps, & blowers. Company makes available literature on its line of pulsation snubbers.

 T486 Burgess-Manning Co.
- Sefteners, Water.....Bulletin describes principle of operation, applications and construction features of L. A. Zeolite Water Softeners. Includes sample specifications, layout, dimensions. Request Bulletin 105.

 478B L. A. Water Softener Co.
- Strainers, Fine Screen.....Yarway fine screen strainers are available in iron or steel with rust-resistant finish, also bronze, stainless steel & aluminum. Full data on features in Strainer Bulletin S-204.

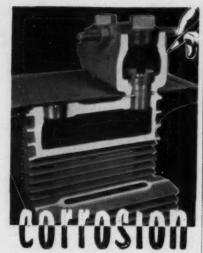
 *Yarnali-Waring Co.
- Tables, Concentration.....Separate materials into bands & handle coarsest sands with excellent results. Ideal for separation of groups of particles having similar range of specific gravities. Bulletin TI-B3.

 *Denver Equipment Co.
- Thickeners, Continuous.....Uses—washing slurry to remove impurities...
 thickening prior to filtration ...
 thickening instead of filtration decantation involving "fines." For Complete details, request Bulletin 122,
 384e *T. Shriver & Co.
- Washers, Air.....Compact and sectional in construction, for quick, easy erection. Available in many standard sises, also custom designed for special applications. Request more complete information.

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September 1956—CHEMICAL ENGINEERING



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LITERATURE . . .

Wire Cloth.....80 p. catalog describes company's facilities for fabricating wire cloth parts. Includes wire cloth parts for screening, filtering and special uses. Also provides helpful metallurgical information. 398 "Cambridge Wire Cloth Co.

Wire Cloth & Screen.....In order to improve your filtering, straining, sizing operations, specify Ludlow-Saylor wire cloth & screen. Give better resistance to heat & pressures. Condensed Screen Reference Catalog.

409 *Ludlow-Saylor Wire Cloth.

Pumps, Blowers, Compressors

Blowers, Centrifugal......Un-plasticized rigid polyvinyl chloride blowers for expelling corrosive air, fumes and gases are discussed in bulletin. For complete details, company makes Bulletin 102 available on request.

479A Industrial Plastic Fabricators.

Biowers & Exhausters, Centrifugal.....
Bulletin presents typical applications, general specifications and operating features of centrifugal type blowers and exhausters for air or gas. Request Bulletin B-7. 479B Lamson Corp.

Compressors, Air.....For any air needs in the 150-4500 hp range, Clark offers an ultra modern balanced/opposed compressor to fit every application. For complete details, request Bulletin No. 118.

*Clark Bros. Co.

Compressors, Air....I & E Diesel-driven, portable, engine-compressors range in air capacity from 55 to 320 cubic feet per minute. They are completely air cooled and require no liquid coolant whatever. See Bulletin.

4790 Air Compressors Inc.

Compressors, Centrifugal.....Offers a complete line of centrifugals for gas compression and refrigeration—up to 10,000 horsepower in a single unit. Details in booklet, "Centrifugal Compressors for Industry."

2 Carrier Corp. *Carrier Corp.

mpressors, Oil-Free.....Joy WG-9 oil-free compressors are equipped with carbon graphite piston rings. Need no lubrication, and compensate auto-matically for wear. For further in-formation, request Bulletin 104-11.

Fans, Axial Flow.....Series of new aero-dynamically designed axial flow fans feature wider blades which offer high-er pressure characteristics with less operating noise. Full information available on request.

479D Detroit Blower Corp.

Fans, Centrifugal.... Sturtevant Division announces new line of centrifugal fans with Airfoil blading. Sixteen fan models are offered with wheel di-ameters ranging from 27 to 108 inches in diameter. Request details. 479E Westinghouse Elec. Corp.

Fans, Propeller.....Revised catalog contains new fan sizes not shown in previous edition as well as revised air deliveries, specifications, performance data and dimensional drawings on entire line. See Builetin A-109B, 479F Hartzell Propeller Fan Co.

Pumping & Heating, Fuel Oil. Gives information on fuel oil pumping & heating units designed to prepare, for combustion, all grades of fuel oil including No. 7 or Bunker "C" oil & residums. Bulletin 40.

B477 "National Airoil Burner Co.

Pamps.....Practical Guide to Pump Se-lection—illustrations & descriptions with capacities & adaptability of pumps contained in compilation of facts to help avoid costly misapplica-tion. Bulletin No. 8-146. L463

* From advertisement, this issue



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Pumps.....Bulletin describes gear-inhead type pumps. Covers basic construction and design, wide range of types and sixes available, field of application and specifications. For full details, see Bulletin WQ-8205. 480A Warren Steam Pump Co.

Pumps......Bulletin describes standard and hopper types of double external bearing and gear screw pumps. Ofter wider range of application, more rugged shafts, improved bearing lubrication. See Bulletin WQ-S206. 486B Warren Steam Pump Co.

Pumps, Acid.....On most difficult pumping jobs., dependable highly efficient pumps deliver continuous, trouble-free performance on round-the-clock schedules wherever they are installed. Full details.

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*A. R. Wilfley & Sons.

Pumps, Acid.....Mighty midget for pumping acids. Jabsco neoprene-impeller pump made of Ace hard rubber outlasts, out-pumps anything in its pressure, size and price class. Full details in Bulletin No. 97-A.

373b *American Hard Rubber Co.

Pumps, Centrifugal.....Line includes process and solids handling pumps as well as general purpose types. Offer improved product quality, streamlined production, increased profits. Request details.

85-46f *Allis-Chalmers Mfg. Co.

Pumps, Centrifugal.....Impervious graphite pumps feature mechanical seal with enclosed coolant, rugged type SN armored connections, interchangeable parts, wide capacity range, etc. Catalog Section No. S-7250.

338b *National Carbon Co.

Pumps, Centrifugal......Describes construction features, performance data and pump specifications of Goulds Fig. 3655 line containing 20 sizes of pumps, with capacities up to 2000 gpm and heads to 400 ft. Bul. 716.1 4800

Pumps, Diaphragm.....Cut operating and maintenance costs in handling corrosive, abrasive, viscous, heavy or delicate fluids. Positive, double reciprocal piston pump requiring no packings (no leakage). Bul. 137A.

3844 *T. Shriver & Co.

Pumps, Direct Flow.....Illustrates & describes the Aldrich 6" Stroke Direct Flow Pump Series. Includes Triplex, Quintuplex, Septuplex & Nonduplex Pumps, ranging in power from 300 to 900 hp. Data Sheet 67A.

404 *Aldrich Pump Co.

Pumps, Displacement.....Bulletin describes 21 different sizes of type "C" constant displacement radial piston pumps. Includes construction, operation, speeds, capacity and pressure ratings. See Bulletin 46000. 480D Oligear Co.

Pumps, Gas.....Positive control of volume and pressure, with the simple rotary impelier principle. Details in two bulletins, Bulletin 31-B-17 for small sizes & Bulletin 32-32-B-13 for larger units. 450 *Roots-Connersville Blower.

Pumps, Industrial.....Jabsoo Industrial Pumps: instantly self-priming; simple, compact, only one moving part; durable neoprene impeller; self-lubricated; trouble-free operation. Request catalog sheets. T485 "Jabsco Pump Co.

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LITERATURE . . .

Pumps, Piston-Diaphragm.....For controlled-volume pumping of fluids. Flow-charts, typical applications, description & specifications & models of various capacities & constructions in Bulletin No. 440.

**Lapp Insulator Co.

Pumps, Process.....DeLaval CPO-process pumps handle numerous liquids; salt brine; sea water; caustic solution; scap solutions; etc. Capacities to 2000 gpm—heads to 200 ft. Details in Bulletin No. 1125-B.

172 *De Laval Steam Turbine Co.

Pumps, Process.....Type Z4 APCO process pump is ideal for the handling of liquefied petroleum gases, refrigerants & other light non-viscous liquids. Latest design features. Bulletin 111-ZA available.

T487

*Aurora Pump Div.

Pumps, Serew.....Two general types: gear-in-head for handling lubricating liquids free of corosive elements and solids; double external bearing and gear for handling all other liquids. Details in Builetin Wq-2205. 461 *Warren Steam Pump Co.

Pumps, Sinrry.....Complete details of the Manzel SP-90 Siurry Pump are contained in a Bulletin. This new pump prevents settling; pumps siurries at rates varying from over 15 gals maximum to 24 gals. mini-mum per hour. *Mansel Div.

Pumps, TurbineTurbine pumps used to deliver water from deep wells, lakes or streams for factory water supply. In many cases, these pumping units have cut water costs in half. For details, see Bulletin 6700. 468 Deming Co.

Services, Processes, Misc.

Chemicals, Textile....."Calgon Data for the Textile Chemist" highlights value of proper water conditioning in tex-tile industry. Calgon is considered an essential chemical in preparation & dyeing of textile materials. 481B Hagan Corp.

Cleaning & Sanitizing, Oil Processing Equipment....."How to Clean Edi-ble Oil Processing Equipment" will be helpful to processors as a ready ref-erence on current methods of clean-ing and sanitising their equipment. 4810 Oakite Products.

Coordinated Precision Technology.....
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243 *General Precision Equip. Corp.

Design & Engineering.....Brochure gives outline of comprehensive engineering and consultancy service to the chem-ical and petroleum industries. Exam-ples of designed, engineered and erected plants. Request Brochure. 481D Petrocarbon Developments.

Engineering Services......Help protect your equipment investment—applica-tion engineering, analytical engineer-ing, product development, field-serv-ice engineering, maintenance service, etc. Bulletin GED-2244. 42-3 "General Elec Co.

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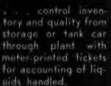


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LITERATURE . . .

Fire Protection.....28 p. covers various methods of fire detection, fire provention, fire control and fire extinguishment associated with the field of "Special Hazard" fire protection. Fully illustrated Catalog 73.
482A "Automatic" Sprinkler Corp.

Laboratory Equipment....Batch and continuous test models of crushers, screens, ball mills, pulverizers, rod mills, classifiers, agitators and mixers, pulp distributors, feeders, etc. Data in Bulletin LG3-Bio.

3911 *Denver Equipment Co.

Laboratory Glassware.....File folder provides easy method of retaining information on Doerr lines of laboratory glassware for future reference. Data Sheets issued regularly for filing. Data Sheets 1 & 2 available now. 482B Doerr Glass Co.

Laboratory Ware.....Offers many properties important to development, experimental or analytical work. It is chemically stable, stands temperatures to 1900° C, and is easy to clean. Complete data in Bulletin 793.

482° Norton Co.

Lubricating Systems.....2 p. service instruction sheet provides service information and operating instructions for built-in "One-Shot" lubricating systems. Request your copy of instruction sheet on KI lubricators.

482D Bjjur Lubricating Corp.

Lubrication Systems..... "Spray Valve Panels" are designed to spray-lubricate bull gears, girth gears such as on grinding mills & klins, & other spur on herringbone gear trains. Details in Bulletin No. 26-R. 12 *Farvai Corp.

Maps, Physical.....Presents a huge physical map of New York State and adjacent areas. Includes information relating to boundaries, transportation, population of the numerous cities, elevations in feet, etc.

482E N. Y. State Dept. of Com.

Plant Sites...... Data on raw materials, transportation, power and fuel, markets, labor, facilities, sites, community services, laws and regulations, etc. Also includes physical map. "Industrial Location Services." *N. Y. State Dept. of Com.

Porous Mediums.....Plates and tubes with uniform porosity over entire area. Made of strong, chemically stable Alundum material, engineered for high resistance to acid and alkali conditions. Request literature.

482F Norton Co.

Roll-Setting......Hydra-Set is a unique hydraulic roll-setting device that takes all guesswork out of roll settings. Comes as optional equipment on new mills or as field conversion kit. Spec. Sheet No. I-400 R.M. 371

Safety Equipment.....Scott Air-Paks cut repair & maintenance costs. On hasardous jobs, Air-Paks help management & labor to breathe easier. Request booklet, "Scott Air-Paks Save Money, Man Hours." 370 *Scott Aviation Corp.

Services & Facilities, Testing.....72 p. bulletin covers chemical, electrical, electronic, mechanical and physical, and photometric, radiometric and colorimetric testing. Copies of bulletin available on request.

482G Eleci. Testing Labs.

Water Well Systems......Covers Layne water well systems, oil and water lubricated Vertical Turbine Pumps, special water well drilling, service work, shutter screens, irrigation wells and pumps, etc. See Bulletin No. 100, 482H

* From advertisement, this issue

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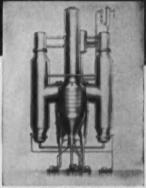
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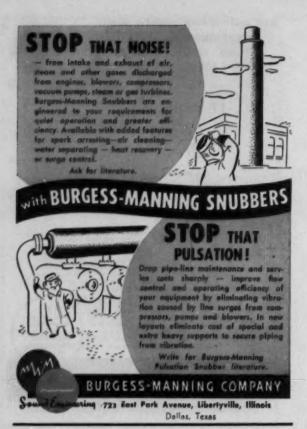
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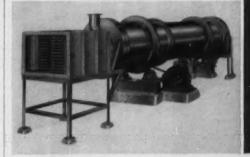
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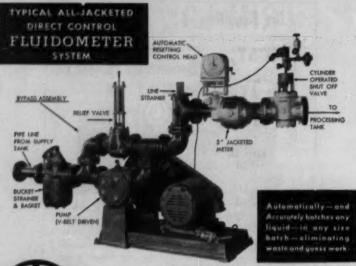
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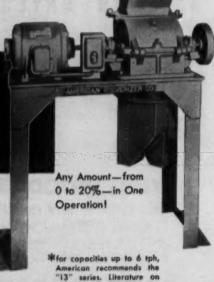
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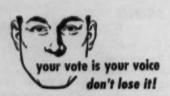
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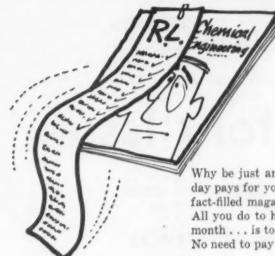
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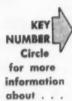
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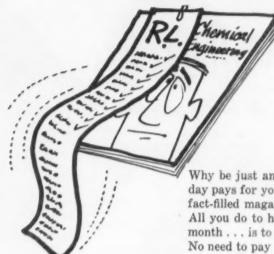
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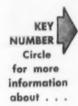
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83	78d	123g	156	223a	260B	201a	325	375e	406	456A	461	467B	474C	B482a
83	78e	125	157a	233Ъ	260C	201b	326	377	407	456B	461A	467C	474D	B482b
24	70	127a	157b	233a	200D	201e	328	378a	408	456C	461B	467D	474%	B482e
85-40a	80	127b	157e	2334	200E	201d	330a	378b	400	456D	403	467E	474P	482A
35-40b	81a	127e	158	233e	260F	200	330b	378e	410	4568	463A	468	L478a	482B
85-40a	81b	127d	160	233 (261	205-300a	381	279	411	456F	482B	465A	L475b	482C
85-40d	Sle	127e	161	233g	262A	293-800b	332	380	412	456G	463C	4668	L478a	482D
35-40e	81d	1271	163	234-5	262B	208-800e	333-4	381	413	456H	462D	468C	L4764	482E
35-401	Sie	127€	163	237	262C	298-900d	335	382	647	4841	462B	408D	B478	482F
35-40g	811	127h	184	236	262D	200-300a	336	388	448	457	403P	4668	475A	483G
35-40h	81g	120	165	341	262E	209-300/	337	384a	440	457A	483G	L489	475B	489H
35-40	85	181	166	248	268	293-300g	228	384b	450	457B	1,463	R469a	476C	T484
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41	85	135	168	247a	264B	293-3001	340	384d	453	457D	453A	480A	B477	T455
42-3	86	137	109	247b	264C	203-300)	341	384a	433	487E	463B	460B	477A	B485
44-5	87	139	170	247e	264D	208-500k	342	3847	454A	487F	469C	469C	477B	T486
66-7a	88	141	171	3474	264E	293-3001	343	386	454B	458	463D	400D	477C	B496
46-7b	86	143	173	247e	265	203-800m	345	T387	454C	455A	443E	480E	478A	T487
16-7e	90	146A	178	250A	268A	293-300a	246s	3387	454D	45633	463F	ANGP	478B	D487
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10-1	94	147a	215b	258	266D	292-800q	251-2	390	454G	458E	464B	470B	BR479	493
12-4	9.5	147d	215e	254A	267	208-200r	228	392	454H	4567	484C	470C	479A	495
64-6	96a	148A	317	254B	271	203-800s	389	294	4541	459G	484D	470D	479B	49.6
56-7	64b	1480	219	254C	278	203-3004	343	395	4542	458H	464E			

TO ORDER REPRINTS

Indicate quantities for each (See page 490)

FOR CHANGE OF ADDRESS (Give both old and new address) Old Address
New Address

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Street: City: State:

P.S. Did you miss anything in

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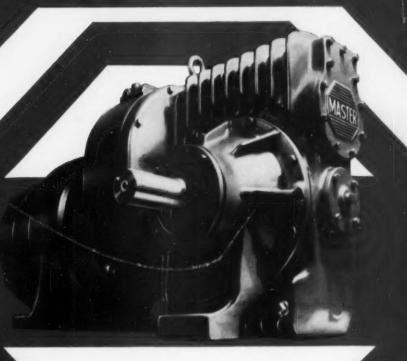
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